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ARCHIBALD BROWNING.

PIONEER BREEDER OF THE REAL AUSTRALIAN "DOWN" LAMB.

GEO. L. SUTTON, Director of Agriculture.

In one of the very attractive window displays arranged as part of the advertising campaign in connection with New Zealand Frozen Lambs, the following slogan was displayed:—

NEW ZEALAND LAMB: THE BEST IN THE WORLD.

A proud claim and, taken as a whole, a just one and surely a challenge to all breeders of lambs for export. Archibald Browning, of Yarrawonga, Victoria, so regarded and accepted it.

In 1925 Mr. Browning was in Great Britain and, as a breeder of lambs for the Victorian market, was considering the possibilities of extending his activities and catering for export trade to the Smithfield market. At that time the prices obtained for *all* Australian lambs were definitely and decidedly lower than those obtained for lambs from New Zealand. Mr. Browning determined to ascertain the cause of this unsatisfactory state of affairs with a view to remedying it, and decided to make inquiries at the very heart of the lamb trade, that is, from the buyers of our frozen lambs in the Smithfield Market. Supplied with the usual official introductions, he visited the markets and was shown around with great courtesy but received evasive replies to his pertinent question—"What is wrong with the Australian lambs?" Mr. Browning is persistent and thorough and so, nothing daunted, he continued to visit Smithfield, always seeking the answer to his question. Eventually he found a lamb salesman, Mr. Hamilton, manager of Hayes, Payne and Knowlden, who, possibly in exasperation, decided to risk offending this determined Australian by supplying him with the information he seemed so anxious to obtain. Mr. Hamilton commenced by asking—"What is *right* with the Australian lamb?" and then proceeded, "It is long shinned instead of plump legged and gives little satisfaction to my clients; much of it is too old and is really immature mutton instead of young, sappy lamb. You Australians are wool growers and obsessed with

the idea of a wool sheep, and seem unable to realise that at Smithfield meat, *not* wool, is required. To achieve success at Smithfield, the best *carcase* sheep and not the best *wool* or even a *dual purpose* sheep must be used to supply its requirements." Here, then, was very definite and reliable information from a fountain head, and though it might be unpalatable, it could not be disregarded by an earnest seeker after fundamental truths concerning the export lamb. The next step was to

ARCHIBALD BROWNING,
"Riverslea," Yarrawonga, Victoria.
The Pioneer of the Australian "Down" lamb.

examine thoroughly the best New Zealand carcases which were giving so much satisfaction; a close investigation of these showed that those used for display purposes were always of the *Southdown* type, evidently produced by mating Southdown rams with long wool ewes or with long wool crossbred ewes.

Because of his experience as a lamb breeder and his knowledge of the methods of the export lamb breeders, Mr. Browning concluded that the key to successful competition with New Zealand was the use of the Southdown ram, mated with long wool crossbred ewes.

Immediately on his return he placed an order with a local breeder for a line of Southdown rams and mated these with 400 long wool crossbred ewes. Later he

The Real Australian "Down" Lamb.—Pioneer shipment of the Yarrawonga Lambs, 1926.

turned them amongst another 800 ewes, the balance of his flock, and that year had 500 Southdown type lambs. Of these 265 were sent in due course (1926) to Smithfield. Compared with that of the usual Australian lamb, their quality was so exceptional that their arrival created a mild sensation, and at once and conclusively established the fact that Australia can produce lambs equal in quality and

superior in colour, to those of New Zealand. The illustration herewith shows portion of this first consignment as exhibited at Smithfield. Each year since then a further consignment, in one year 1,000, but usually 700 to 800, has been sent to Smithfield and always with the same excellent result.

So noteworthy is the quality and so excellent the colour of the "Browning" or "Yarrawonga" lambs that a few hundred, out of nearly twice as many millions of New Zealand and Australian lambs, have had special attention called to them in the trade papers each year. On 30th September, 1930, the Commonwealth Veterinary Officer at the Smithfield Market wrote:—"The 'Yarrawonga' Down cross lambs which have been so favourably received always, have invariably made ½d. per lb. more than the New Zealand and 1½d. per lb. more than G.A.Q Australia," and, moreover, they have established for themselves such a good name that they can be disposed of in advance of their arrival at this margin.

When in London again, in 1930, Mr. Browning asked the foreman of the meat department of "Harrods" if they purchased Australian lamb, and was advised that he did not as the quality did not suit his customers, but he added, "We get a few of a special line that comes along every year. They are excellent quality and highly please our customers, who ask for further supplies which we cannot obtain. They are then dissatisfied with the quality of the best of the others." Seeing that he was speaking about the famous "Yarrawonga" lambs and to the breeder of them, but did not know it he was paying an unconscious, but very fine and well deserved compliment to Mr. Browning. It also goes to prove that if more special quality lambs were exported, the demand for them would still further improve with a continuity of supplies.

Mr. Browning is emphatic that in Australia there is a large area of country suitable for raising first class lambs. He states that on such country, in normal seasons and with proper treatment and attention, lambs will become as fat as seals on natural pasture and quite as prime as they do in some other countries with hand feeding. When nature is so good, why take second place to any country?

The town of Yarrawonga, after which these celebrated lambs have been named, is on the Victorian side of the Murray and is the head of a branch line running 40 miles Northwards from Benalla on the main line, Melbourne to Albury. It is 161 miles from Melbourne, whither the lambs are sent for treatment by a train which leaves Yarrawonga at about 2 p.m. and which arrives at the export works the next morning. They are slaughtered, weighed, and frozen during that day. The country is gently rolling until near the river, where it becomes much more level and, because of the trees, has a fine park-like appearance. At the time of my visit, 19th January, the natural feed was dry and interspersed with stubble. On the whole it was very similar to that found in our forest wheat areas.

The Yarrawonga district is a first class wheat growing area with a good winter rainfall. The average annual rainfall for the past 51 years to 1931 was 1,951 points. During that period it has ranged from 1,231 points in 1927 to 3,169 points in 1889. Of particular interest is the rainfall recorded since 1926, when the first shipment of the Browning lambs was made, and hereunder will be found the monthly rainfall recorded during that period.

Year.	Jan.	Feb.	Mch	Apl.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1926	33	...	282	458	215	271	213	237	144	157	17	91	2,118
1927	56	55	15	2	136	78	165	212	104	224	96	88	1,231
1928	240	336	460	120	128	188	132	48	101	140	1	66	1,960
1929	24	262	203	318	72	92	80	163	151	88	30	178	1,611
1930	...	3	93	100	142	39	86	233	68	304	96	581	1,745
1931	101	43	343	305	594	543	151	116	122	147	193	4	2,662

Mr. Browning's farm, "Riverslea," is situated about three miles West of the town of Yarrawonga, and about 60 miles West of Albury. It consists of 2,000 acres of gently rolling land, and is a typically good wheat farm of rich red loam, valued at not less than £16 per acre before the present depression began. The land is capable of producing up to 36 bushels of wheat per acre, and has yielded over a number of years on well fallowed land an average of 25 bushels. Up till 1931 Mr. Browning grew wheat on a bigger scale. At present from 500 to 600 acres are cropped annually on fallowed land, as it is found that cultivation is necessary in order to secure the best grazing results. It is found that the best feed, mostly trefoil, is obtained in the stubbles the first season after cropping, the land coming back into pasture very quickly. Of the area under crop, about 100 acres are planted with oats, also after fallow, in order to supplement, if necessary, the natural feed available for the ewes and lambs.

The property has over a mile of frontage to the River Murray. There are also 60 acres of river land graded, etc., and used for irrigation, and of these about 30 acres are under lucerne which is largely grazed at certain periods by a small stud of Southdowns and the house cows. Lucerne hay is also made from this plot. Some 30 acres are sown with barley in the early autumn to provide green feed for the lambing ewes that may show signs of sickness after being on the dry feed throughout the summer.

A breeding flock of about 1,200 ewes is carried, and these are purchased, not bred on the farm. Mr. Browning is willing to use almost any long woolled ewes, but he is very particular about obtaining good types and will wait a long time to secure a suitable line. A straight line of even type, early drop, station bred ewes is what he aims at getting every three years, with 56 to 58 grade of wool. The line must be of good conformation, preferably with straight even backs and the tail well set, etc. At the time of my visit, owing to the difficulty of securing lines of this type, the flock had been kept on longer than usual, and had been supplemented to the required number. In the line were first cross ewes from the Merino by Border Leicester, Romney and Lincoln rams, and a few large well-set comebacks, the line keeping to the standard of wool previously mentioned. Mr. Browning states, "There is no better ewe to breed the shapely export lamb than that produced by crossing the Border Leicester ram with the big Merino ewe, and if men in the store sheep belt or drier agricultural areas would encourage this style of breeding and concentrate more on shape, they would find the business a profitable undertaking, and they would help to overcome one of the greatest difficulties in the export lamb business in Australia to-day, viz., the difficulty of securing suitable ewes for breeding prime lambs. As it is at present carried out many of our lamb breeders are endeavouring to breed export lambs from ewes which were culls themselves from previous seasons. Excellent ewes for export lamb breeding are produced by mating Merino ewes with either English Leicester, Border Leicester, Lincoln or Romney Marsh pure bred rams, but even with this mating, to achieve the best results, severe culling is necessary."

His invariable practice of securing his ewes in a single line led him to lose, in 1930, a very fine lot of Border Leicester crossbred ewes which he liked and which were secured by a friend of his. Mr. Browning later on judged some of the progeny at a country show; he considered that they were, if anything, better than his own lambs. This view was confirmed later by the following extract from a letter sent from London to the manager of the Western and Murray Co-op., Ltd., which treated the lambs:—

> "You might be good enough to extend to Mr. Bott my hearty congratulations for producing such fine specimen of the ovine; in fact I am safe in saying they excelled the famous Yarrawonga lot—a more level line one could not wish for."

This is eloquent testimony to the value of the Border Leicester crossbred as a mother for the export lambs and confirms Mr. Browning's preference for it. He considers that the conformation is specially suitable, because of its fine, level back.

In addition to the flock of 1,200 long wool ewes, the farm also carries a small stud of about 75 Southdowns. The Southdown stud has been established to supply flock rams of the blocky, low-set type desired for the production of the Australian Down lamb. To place at the head of this Southdown flock, Shripney Ramsay Mac has been imported from the Shripney Stud, Essex, England, and, at the time of my visit, was in quarantine. He is a thick- low-set animal, with boldness and character. Mr. Browning has been unfortunate in his importations, as two previous rams died, the first one whilst in quarantine and the second as the result of an accident. He has also imported several high class ewes. The first ram imported was an outstanding animal for, as a ram lamb, he not only won in his class at the great Southdown Show at Chicester, but also obtained a unique victory by winning championship honours when competing with adult animals. This was the first time in the history of this great show and sale that the championship was won by a ram lamb, and on this occasion there were 800 rams and approximately 4,000 ewes from registered flocks competing.

Mr. Browning is definitely of the opinion that his success is due to the use of the Southdown ram which, he states, is the only ram to use for the production of choice export lambs. He is confident that, whilst other rams will produce good lambs, none of them will produce the special lamb which is required on the London market, particularly when the market is not buoyant.

Despite his noteworthy and outstanding achievements in connection with the production of special quality export lambs, there are settlers in Victoria and even in his own district, who disagree and claim, as do some in Western Australia, that other breeds are "just as good." So far the results obtained have not justified such a belief. As opposed to the belief in the value of the "just as good" sire are the following details relative to some lambs bred during the past season on a well known property on the Murray in Riverina. A number of consignments were exported to Smithfield, and the particulars of the first three trucks are available. These lambs were bred from ewes which could be termed mostly first cross, and the rams used were Southdowns, Dorset Horn and Border Leicester. The different breeds of rams were mixed together with the ewes in the same paddock, under exactly the same conditions. When the lambs were considered fit for market they were drafted in the usual way through the race, and the three trucks consigned on the same day to the Western and Murray works. On arrival and after being slaughtered the parcel was graded in the following manner:—

114 1st grade Southdown cross lambs, average frozen weight 34.6 lb.

214 1st grade Australian lambs, Dorset Horn and Border Leicester cross, and 39 2nd and 3rd grade Australian lambs, Dorset Horn and Border Leicester cross, average frozen weight 34.9 lb.

On arrival at Smithfield the consignment was sold on the same market with the following results:—

Southdown Cross-bred Lambs (114)—

	£	s.	d.
Average weight 34·6 lbs.			
Gross return, London	1	4	7
Less London charges	0	1	5
	1	3	2
Plus exchange	0	7	6
Total	£1	10	8

Australian Lambs.

Dorset Horn and Border Leicester Cross-bred Lambs (253)—

	£	s.	d.
Average weight, 34·9 lbs.			
Gross return, London	**0**	**19**	**6**
Less London charges	**0**	**1**	**5**
	0	**18**	**1**
Plus exchange	**0**	**5**	**5**
	£1	**3**	**6**

Relative London Returns.

Breeding of Lamb.

Ram—	Ewe—	£	s.	d.
Southdown	Longwool Crossbred ...	1	10	8
Dorset Horn / Border Leicester	Longwool Crossbred	1	3	6
	Difference ...	£0	7	2

The relative rates per lb. for the four different quality grades ruling at that time were:—

1st Down lambs	8.52 pence.
1st lambs	7.08 pence.
2nd lambs	5.79 pence.
3rd lambs	5.50 pence.

It is stated that a corresponding discrepancy existed throughout the season with the other consignments from this property, consisting of about 4,000 lambs in all.

Mr. Browning's practice is to mate the ewes at the beginning of December so as to have the lambs commencing to drop at the beginning of May. He experiences no difficulty in mating at this time, and believes that this is largely due to his practice of purchasing ewes bred in districts to the North of Yarrawonga, *i.e.*, in drier and earlier districts. During the summer the ewes are fed on wheat stubbles and dry natural grass which may be in the other paddocks. The average percentage of lambs marked is 90 per cent. At lambing time the ewes are carefully watched and every two or three days the newly dropped lambs and their mothers are removed from the remainder of the flock and placed upon the best feed available. Everything is subordinated to the welfare and the rapid growth of the lambs. To this end they are given a frequent change of paddocks. Even though there may be no improvement in feed, Mr. Browning is definitely of the opinion that it is advisable to give the ewes and lambs a frequent change. The paddocks are about 100 to 320 acres in area. Under normal conditions the lambs are ready for despatch to the export works when about four months old. As soon as the first lot is ready for market scales are taken into the yards and remain there until the season is over. The scales are used to check the judgment regarding the smallest lambs and any lamb otherwise satisfactory and weighing 65 lb. or over is sent to the works.

Hereunder are some details relative to the first consignment of two trucks of Browning lambs set away during the season just ended.

Incidentally they also furnish interesting information regarding the precocity of the Southdown crossbred.

Details of first consignment of Browning lambs, season 1931.

May 1st—First lamb dropped.
Aug. 30th—Two trucks lambs despatched to Western & Murray Co-op.
Aug. 31st—Lambs slaughtered, weighed and frozen.
Sept. 9th—Lambs shipped per T.S.S. "Bendigo."
Nov. 6th—Total proceeds received Yarrawonga per telegraphic transfer.

Returns:	£	s.	d.
Average frozen weight of lambs—32½ lb. at 9d.	1	4	4.5
Exchange 30⅜ per cent.	0	7	4.8
Total	£1	11	9.3

Only lambs which comply with a certain standard are exported. Those which are stunted or misshapen or do not conform to the Southdown type are rigorously culled out and sent to the Melbourne market. What is Mr. Browning's standard may be judged from the following scale of points which Mr. Browning has set up for judging export lambs and export carcases:—

The Browning Scale of Points.

Export Lambs:	Points.
Type and general conformation (low set, compact body, short legs and neck, level and broad back with wide, flat loin)	15
Back and loins from the neck to the setting of the tail	10
Breech and depth of quarters	10
Evenness of pen as regards matching	10
Value of skin	5
	50

Export Carcases:	
Correct amount of fat and proportion of lean flesh to fat ..	15
Back and filling over the loins	10
Depth and twist of meat on all four quarters	10
Colour and bloom	10
Weight (maximum points to be awarded to weight grade 2—28 to 36 lb.)	5
	50

The adherence to the standard set involves a retention of 10 per cent. of the drop, but it has earned for Mr. Browning a very valuable "goodwill" for quality and reliability and, in consequence, as pointed out by the Commonwealth Veterinary Officer at Smithfield, the Yarrawonga lambs can be sold in advance at ½d. per lb. above the best New Zealand lamb.

Archibald Browning's achievement has not only brought honour to his district, but has rendered signal service to the Commonwealth, the extent of which it is difficult to evaluate. With a keen desire for service, he is desirous that the benefits which have accrued to him should be secured by all Australian producers of export lambs. The advantage of colour which he has shown that Australian lambs possess is nature's gift to Australia, but his improvement in quality has been due to

the breeding practice adopted and the husbandry skill used to bring the advantages of that practice to their full fruition. Like Columbus, Mr. Browning has charted the new track; our responsibility is to follow it and increase the individual and national income. Just what that increase may be, may be gauged by the fact that not ten per cent. of the three million Australian lambs exported are of the Southdown type and these, at present, are worth 1½d. lb. more than the first grade Australian lamb, but it is believed that when the percentage of the Southdown type lamb is very much greater, the general effect will be to raise also the price level of the better grades of the other type.

THE "ROYAL" AND DISTRICT AGRICULTURAL SOCIETIES' 50-ACRE CROP COMPETITIONS, 1931.

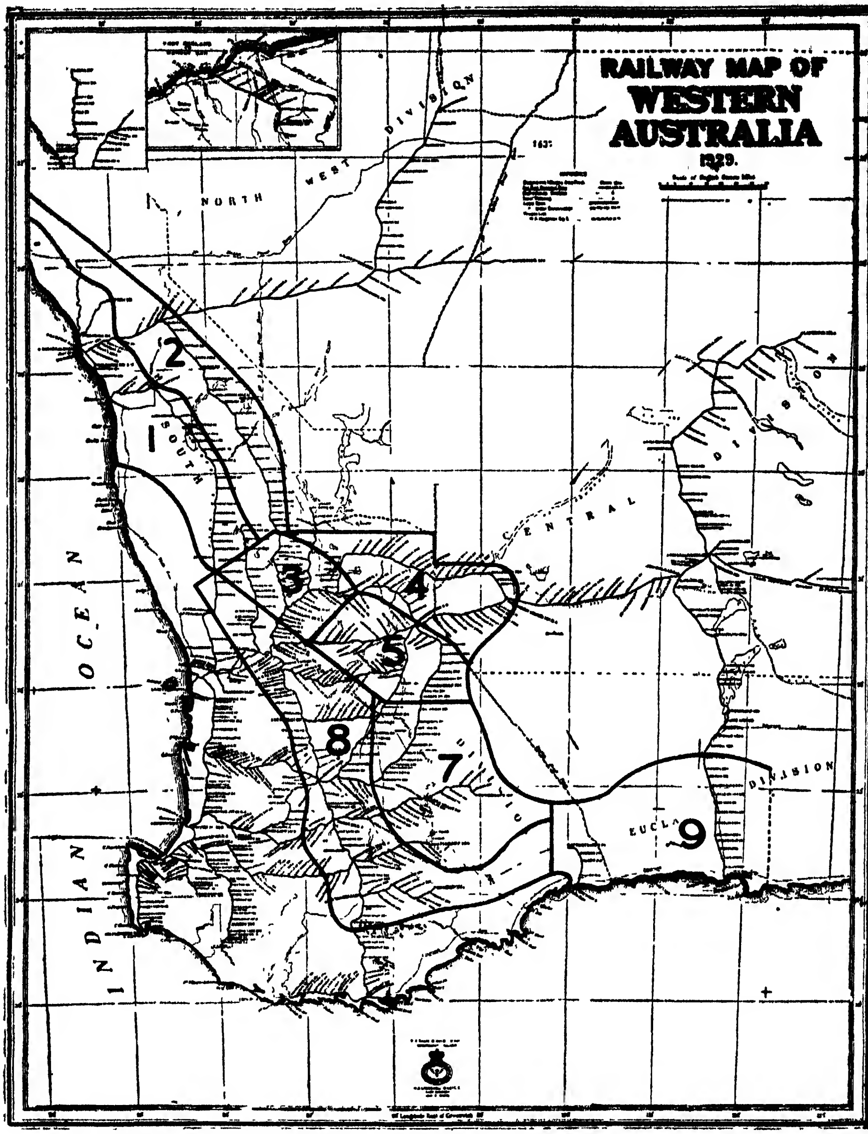
I. THOMAS,
Superintendent of Wheat Farms.

Eleven years ago the first Royal Crop Competition in this State was conducted. Starting in a small way, with fifteen entries, the crop competitions have grown in importance and improved in technique, until to-day they occupy no mean part in the life of the agricultural community. In the earlier competitions the entries were received direct by the Royal Agricultural Society, but in 1923 affiliated District Agricultural Societies were encouraged to conduct district crop competitions, and the first and second prize winners of each district competition competed for the Zone Championships. This effected a very considerable improvement in the number of entries. Farmers living in localities where no district competition is being conducted are not debarred from competing, as they are permitted to make their entry direct with the Royal Agricultural Society.

As can be readily understood, there is a considerable variation in rainfall, soil, etc., in a wheat belt so widely scattered, extending, as it does, from Ajana in the North to Scaddan in the South-East. A subdivision has therefore been made, and the wheat belt divided into eight zones, in such a manner that districts having similar interests and climatic conditions have been grouped together. This division was made in 1925 and has remained unchanged, excepting for a few alterations, the most important of which were the creation of a new zone, No. 9, in 1929, to embrace the Ravensthorpe and Esperance areas, and the elimination of No. 6, which was absorbed into No. 8. This division of the wheat belt has the added advantage of making it possible for the one judge to inspect all the competing crops in the one zone. The accompanying map shows the eight zones referred to.

In each of these zones a championship prize of £10 and a second prize of £2 10s. are awarded. The competitors eligible for these awards are the first and second prize winners of the competitions held by the affiliated district Agricultural Societies, and those competitors who have entered direct with the Royal Agricultural Society, because of no district competition being conducted in their own district.

In addition to these zone prizes the Royal Agricultural Society each year offers a special prize of £5 5s. to the competitor in any zone obtaining the highest calculated bushel yield per acre. This prize was first offered in 1925.



The conditions of the competitions require that the crop shall be grown on fallowed land, shall not be less than 50 acres in area, of one variety, and shall be judged under the following scale of points:—

Yield	50	points
Freedom from weeds	10	"
Freedom from disease	10	"
Freedom from admixture	15	"
Evenness of growth	15	"
Total	100	"

The system adopted has been to allot one point for each calculated bushel yield, which is determined not by estimation, but upon that calculated from portions of the crop obtained from small areas taken systematically throughout the crop. These samples are then threshed and the grain weighed.

As an indication of the improvement in yields, brought about by these competitions, it is interesting to note the alteration to the scale of points for yield, rendered necessary by the increased yields of the leading competitors, as is illustrated in the following table:—

Year.	Scale of Points for Yield.	Highest bushel yield in Competition.
		bus.
1921	30	...
1922	30	...
1923	35	40
1924	35	36
1925	40	36
1926	40	38
1927	40	40
1928	40	40
1929	50	46
1930	50	43
1931	50	42

Since the inception of the Royal and District Crop Competitions, the judges have been departmental officers attached to the Wheat Branch of the Department of Agriculture.

The awards and judges' reports, together with a detailed analysis of the cultural details of all competitors, have been prepared and will be found in the following pages:—

ZONE 1.

Judge—I. THOMAS, Superintendent of Wheat Farms.

Royal Society, 6 Competitors; Three Springs Society, 5 Competitors.

Total, 11 Competitors.

THREE SPRINGS AGRICULTURAL SOCIETY.

The rainfalls for Three Springs and Arrino were as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sep.	Oct.	Total.	Nov.	Dec.	Total for year.
Arrino	...	...	8	47	459	194	290	193	205	67	1,408			
Three Springs ...	...	...	10	35	499	161	282	191	171	63	1,367	85	44	1,541

The awards made and the cultural details are tabulated hereunder:—

THREE SPRINGS AGRICULTURAL SOCIETY.

Judge: I. THOMAS, Superintendent of Wheat Farms.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Hebiton, J. K., Senr.	Three Springs	Merredin ...	40	8	8	13	14	83
Durack, P. M. ...	Arrino ...	Merredin ...	34	8	8	11	13	74
McKenzie, N. ...	Three Springs	Merredin ...	30	9	8	13	13	73
Thomas, C. E. ...	Three Springs	Federation ...	32	7	7	11	14	71
Hebiton, J. K., Jnr.	Three Springs	Merredin ...	29	7	7	13	13	69

CULTURAL DETAILS

Competitor.	No. of years cropped.	Timber	When ploughed	Condition of land.	Implement	Depth	Subsequent cultivations	Variety.	Planted.	Rate of seed.	Rate of Super	Seed treatment	Graded	Disease
Hebiton, J. K., sen.	5th	York gum	Sept.	Fairly good	Part mould-board, part disc	in. 3-4	Springtyne cultivated Oct., and again prior to seeding. Planted with combined cultivator drill	Merredin	Early May	lb. 60	lb. 80	Copper carbonate	Yes	Small isolated patches of Takeall.
Durack, P. M.	5th	York gum	Sept.	Good	Disc	3	None. Planted with combined cultivator drill	Merredin	1st week June	50	45	No	No	Traces Ball and Loose Smut
McKenzie, N.	6th	York and salmon gum	July	Good	Disc	3	Fed off with sheep. Planted with combined cultivator drill with harrows attached	Merredin	Middle May	45	60	Copper carbonate	Yes	Trace of Takeall.
Thomas, C. E.	? Old land	Morrell, York gum, little salmon gum	Aug. and Sept.	Good	Disc	3	Re disced May. Planted with combined cultivator drill with harrows attached	Federation	1st week June	60	70	Copper carbonate	Yes	Small patches Takeall and traces of Ball Smut.
Hebiton, J. K., jun.	...	..		..	.	..	. . .	Merredin	. . ...	..	..	...	.	Takeall in number of small patches and trace Ball Smut

ROYAL AGRICULTURAL SOCIETY.

Zone 1.

The following are the rainfalls as recorded at the centres where the crops entered direct with the Royal Agricultural Society were grown:—

—	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Coorow ...	...	2	4	53	310	132	310	210	174	69	1,205	76	66	1,406
Carnamah	...	..	12	60	431	167	302	265	204	128	1,497	51	52	1,672
Watheroo	.	.	.	95	449	170	415	331	209	46	1,620	10	42	1,767

The awards made and the cultural details are as set out below:—

ROYAL AGRICULTURAL SOCIETY.

Judge: T THOMAS, Superintendent of Wheat Farms.

Competitor.	Address.	Variety.	Yield. 50 points.	Freedom from Weeds. 10 points.	Freedom from Disease 10 points.	Freedom from Admixture 15 points.	Evenness of growth. 15 points.	Total. 100 points.
Forrester, J. K.	Carnamah	Nabawa	37	8	8	13	14	80
Bothe, B. D	Coorow	Bena	35	8	8	13	14	78
Rudduck, A	Coorow	Nabawa	32	9	8	14	14	77
Cumming, A. S.	Carnamah	Merredin	35	7	8	12	14	76
Hilters & Robertson	Watheroo	Waratah	32	8	7	13	13	73
Green, J. W	Carnamah	Merredin	33	7	7	13	13	73

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
						in.				lb.	lb.			
Forrester, J. K.	About the 8th	Heavy York gum	June	Good	Disc	3½	Springtyne cultivated Aug. and again in Sept. Harrowed Oct. Planted with combined cultivator drill	Nabawa	Middle of May	55	112	Copper carbonate	Yes	Little Takeall.
Bothe, B. D.	About the 10th	Salmon gum	July	Good	Mouldboard	4	Disc cultivated Sept Planted with combined cultivator drill	Bena	2nd week May	55	90	Copper carbonate	Yes	Small patch Takeall and trace Flag Smut.
Budduck, A.	? Old land	Salmon gum and gimlet	July	Good	Mouldboard	4	Tandem disc cultivated last week Aug. Planted with disc drill	Nabawa	2nd week April	48	168	*Nil*	Yes	Little Takeall.
Cumming, A. S.	At least 10th	Salmon gum and gimlet	June-July	Good	Disc	4	Harrowed Sept.. again Oct. Harrowed before seeding with a sunderseeder (Heavy disc cultivator)	Merredin	3rd week May	60	100	Copper carbonate	Re-cleaned	Little Takeall.
Hilfers & Robertson	? Old land	Salmon gum and gimlet	June-July	Good	Mouldboard and disc	2½-3	Skim ploughed with disc implement late Sept. Springtyne cultivated late Oct. Harrowed Feb. Springtyne cultivated prior to seeding. Planted with combined cultivator drill	Waratah	3rd week May	60	85	*Nil*	No	Little Takeall and Ball Smut.
Green, J. W....	? Old land	Salmon gum	June-July	Good	Disc	3-4	Part re-ploughed Planted with combined cultivator drill	Merredin	20th-23rd May	60	90	Copper carbonate	Yes	Little Takeall and traces Ball and Flag Smut.

ZONE 2.

Judge—F. L. SHIER, B.Sc.(Agric.), Agricultural Adviser.

Royal Society, 2 Competitors.

ROYAL AGRICULTURAL SOCIETY.

Zone 2.

Only two crops, both entered direct by the Royal Agricultural Society, were submitted for inspection in Zone 2.

The following tables show the rainfalls for the centres, the awards, and the cultural details of the crops inspected:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May	June	July.	Aug.	Sept.	Oct.	Total	Nov.	Dec.	Total for year.
Indarra	...	...	9	83	378	163	366	311	186	60	1,464	6	43	1,605
Ajana	..	...	33	82	330	105	333	193	116	59	1,136	25	88	1,364

ROYAL AGRICULTURAL SOCIETY.

Judge : F. L. SHIER, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
T. Moore	Indarra ...	Merredin ...	30	9	9	13	14	75
F. A. Porter ...	Ajana ...	Geeralying ...	22	9	9	13	14	67

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Implement.	Depth.	Subsequent cultivations.	Variety.	Rate of Seed.	Rate of Super.	Seed treatment.	Graded.	Disease.
					in.			lb.	lb.			
Moore, T. ...	4th crop ...	Yorkgum and and jam	June ...	Disc ...	3½–4	Springtyne cultivated Aug. and again in Sept. Planted with combined cultivator drill	Merredin	60	90	Copper carbonate	Re-cleaned ...	Trace Takeall.
Porter, F. A. ...	1st fallow	Yorkgum and scrub	July ...	Disc ...	3–3½	Disced during summer	Geeralying	50	112	Copper carbonate	Re-cleaned ...	Trace Takeall.

ZONE 3.

Judge—R. P. ROBERTS, B.Sc.(Agric.), Agricultural Adviser.

Royal Society, two competitors.

ROYAL AGRICULTURAL SOCIETY.

Zone 3.

In Zone 3 also, only two crops were inspected. Both these were entered direct with the Royal Agricultural Society.

The following tables show the rainfalls for the centres, the awards, and the cultural details of the two crops inspected:—

	Jan.	Feb.	Mar	Apl.	Growing Period. May.	June.	July	Aug.	Sept	Oct.	Total.	Nov.	Dec.	Total for year.
Goomalling ...	...	8	13	81	257	136	266	320	139	52	1,170	5	67	1,344
Cowcowing ...	..	13	16	181	239	147	162	224	146	65	983	3	13	1,209

ROYAL AGRICULTURAL SOCIETY.

Judge. R. P ROBERTS, Agricultural Adviser

Competitor.	Address.	Variety.	Yield 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture 15 points	Evenness of growth. 15 points	Total. 100 points.
Woodfield, N. ...	Goomalling...	Gluclub	35	8	8	13	12	76
Jones, W. W. ...	Cowcowing...	Nabawa ..	30	9	9	13	14	75

CULTURAL DETAILS.

Competitor.	Timber.	No. of years cropped.	When ploughed.	Condition of Land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Disease.
						in.				lb.	lb.	
Woodfield, N. ..	Salmon gum and light thicket	Over 12	July	Wet ...	Mouldboard	3½	Springtyne cultivated Oct. Scarified in May. Planted with a disc drill	Gluclub	Middle May	53	90	Takeall.
Jones, W. W. ...	Salmon gum, gimlet, and scrub	8–10	June-July	Good ...	Disc ...	4	Ploughed back with sundercut in Aug. Springtyne cultivated prior to seeding. Planted with disc drill	Nabawa	Last week April	45	70	Traces of Takeall and Bunt.

Both competitors graded and treated seed with copper carbonate.

ZONE 4.

Judge—R. P. ROBERTS, B.Sc.(Agric.), Agricultural Adviser.

Nungarin Society, 10 Competitors; Mt. Marshall Society, 2 Competitors.

Total, 12 Competitors.

NUNGARIN AGRICULTURAL SOCIETY.

The rainfalls for Nungarin and other centres are as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Nungarin ...	...	3	2	202	271	119	184	223	97	93	987	57	21	1,272
Mukinbudin ...	...	...	9	101	269	82	174	133	112	80	850	30	25	1,015
Mangowine ...	...	...	8	97	238	151	120	152	123	52	836			
Bonnie Rock ...	...	7	4	74	255	102	219	106	109	67	858	178	8	1,129

The awards made and the cultural details are set out hereunder:—

NUNGARIN—EASTERN DISTRICTS AGRICULTURAL SOCIETY.

Judge: R. P. Roberts, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Landsell, G. ...	Mukinbudin	Gluyas Early	31	8	9	13	14	75
Creagh Bros. ...	Kwelkan ...	Gluyas Early	30	9	7	14	13	73
Williams, F. ...	Mangowine...	Carrabin ..	27	8	9	14	13	71
Harris, E. G. S. ...	Mukinbudin	Gluyas Early	26	9	8	13	14	70
Jones, D.	Kwelkan ...	Nabawa ...	27	8	7	13	14	69
Hodges, W. S. ...	Nungarin ...	Merredin ...	26	8	7	12	13	66
Manuel, C. J. ...	Mukinbudin	Gluyas Early	22	8	8	14	13	65
Fitzpatrick, R. ...	Nungarin ...	Geeralying ...	24	8	8	11	12	63
Watson Bros. ...	Nungarin ...	S.H.J. ...	21	8	8	13	12	62
Richardson Bros. ...	Bonnie Rock	Merredin ...	16	9	8	12	12	57

CULTURAL DETAILS.

Competitor.	Timber.	No. of years cropped.	When ploughed	Condition of land.	Implement	Depth	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Landsell, G. ...	Salmon gum, gimlet, jam, and mallee	4th crop	June	Good ...	Sunder-cut	in. 3	Springtyne cultivated Oct., and again prior to seeding. Planted with a disc drill	Gluyas Early	1st week May...	lb. 39	lb 83	Copper carb	Yes	Traces Take-all and Flag Smut.
Creagh Bros.	Salmon gum, gimlet, and Yorrel	Old land	July	Wet ..	Disc .	3–4	Rigid tyne scarified, Sept Planted with combined cultivator drill	Gluyas Early	Last week May	45	90	Copper carb.	Yes	Flag Smut and trace Ball Smut.
Williams, F. ...	Salmon gum and gim-let	Old land	June	Good	Rigid tyne scarifier	3	Harrowed in July. Rigid tyne scarified and harrowed Aug. Harrowed prior to seeding. Planted with a combined cultivator drill	Carrabin	14th May ..	45	75	Copper carb	Yes	Trace Take-all
Harris, E. G. S.	Salmon gum and gim-let	Abt. 4th	June	Good .	Scarifier	3	Scarified in Aug. Planted with com-bined cultivator drill	Gluyas Early	1st week May. .	40	80	Copper carb.	No	Traces Flag Smut and Ball Smut.
Jones, D. ...	Salmon gum and gim-let	15th crop	July	Good ...	Disc ...	4	Springtyne cultivated Sept., again in Oct. Springtyne cultivated prior to seeding. Planted with com-bined cultivator drill	Nabawa	End April, be-ginning May	45	90	Copper carb.	No	Patches of Takeall.
Hodges, W. S.	Salmon gum, gimlet, teatree, and some light land	Old land	June–July	Good ..	Disc . .	3	Cultivated with sun-dercut in Aug. Spring-tyne cultivated in Sept., Springtyne cul-tivated beforeseeding. Planted with disc drill	Merredin	1st fortnight May	45	85	Copper carb.	Yes	Some Flag Smut and trace of Takeall.
Manuel, C. J.	Salmon gum and little gimlet	Old land	July	Wet .	Mould-board	3½	Disc cultivated with sundercut Sept. Springtyne cultivat-ed Dec. after rain. Springtyne cultivat-ed before seeding. Planted with disc drill	Gluyas Early	1st fortnight May	40	90	Copper carb.	Yes	Traces Flag Smut and Takeall.

CULTURAL DETAILS—*continued.*

Competitor.	Timber.	No. of years cropped.	When ploughed	Condition of land.	Implement	Depth	Subsequent cultivations	Variety.	Planted.	Rate of seed.	Rate of Super.	Seed treatment.	Graded.	Disease
Fitzpatrick, R.	Morrell, gimlet and jam	Old land	June	Wet	Part with sunder-cut then all crossed with scarifier	3	Scarified in Sept Part scarified and part springtyne cultivated prior to seeding Planted with combined cultivator drill	Geeralying	2nd week May	lb. 45	lb. 70	No	Re-cleaned	Little Ball Smut and traces Take-all
Watson Bros.	Salmon gimlet, and jam scrub	No crop in previous 5 years	July	Good	Sunder-cut	3	Springtyne cultivated prior to seeding. Planted with combined cultivator drill	S H J.	Middle May	48	60	Copper carb.	Re-cleaned	Little Take-all
Richardson Bros.	Salmon gum, gimlet and boree	New land	.	...	.		No cultivations previous to planting with combined cultivator drill	Merredin	8th May	36	50	Copper carb	Yes	Bunt and traces of Flying Smut and Take-all

MT. MARSHALL AGRICULTURAL SOCIETY.

The following table shows the rainfalls as recorded at Bencubbin and North Bencubbin during the year:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Bencubbin ...	...	1	2	86	290	82	126	195	94	56	843	23	14	969
Nth. Bencubbin	...	...	...	79	226	107	170	133	124	82	842	68	19	1,008

The awards made and the cultural details are set out hereunder:—

MT. MARSHALL AGRICULTURAL SOCIETY.

Judge: R. P. ROBERTS, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of Growth. 15 points	Total. 100 points.
Hopwood, B. W. G.	Bencubbin ...	Bencubbin ...	28	9	9	13	13	72
Thomson, M. ...	North Bencubbin	Nabawa ...	24	8	9	12	14	67

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of Super.	Seed treatment.	Graded.	Disease.
						in.				lb.	lb.			
Hopwood, B. W. G.	Abt. 8	Mallee and srcub	June-July	Good	Disc. (Sunder-cut)	3½	Springtyne cultivated Sept. Planted with combined cultivator drill	Ben-cubbin	May 5th ...	38	90	None	Yes	Traces of Takeall
Thomson, M.	Abt. 4	Salmon gum and gimlet	July	Good	Heavy disc	4	Springtyne cultivated in Oct. Planted with combine cultivator drill	Nabawa	May 3rd ...	42	56	Copper carb.	Yes	Traces of Takeall

ZONE 5.

Judge—G. L. THROSSELL, Agricultural Adviser.

Bruce Rock Society, 5 Competitors; Doodlakine-Baandee Society, 2 Competitors; Merredin Society, 7 Competitors. Total, 14 Competitors.

BRUCE ROCK AGRICULTURAL SOCIETY.

The following table shows the rainfalls as recorded at the centres concerned in the Bruce Rock competition:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
(Rosedale) Yarding	...	..	39	53	200	129	234	302	117	52	1,034	13	51	1,190
Bruce Rock ...	..	..	9	160	221	134	216	325	142	44	1,082	16	54	1,321
Emu Hill ...	...	...	11	114	259	148	247	320	132	36	1,142			

The awards made and the cultural details of the competing crops are set out below:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Smith, C. & Sons ...	Yarding ...	Gluclub ...	32	9	9	13	14	77
Allen Bros. ...	Central Kumminin	Gluclub ...	31	9	9	12	14	75
Farrall, F. C. & Sons	Yarding ..	Gluclub ...	29	8	8	12	13	70
Brown, S. A. ...	Bungulluping	Gluclub ...	28	8	8	12	13	69
Smith, C. & A. H. ...	Yalbarrin ...	Gluclub ...	26	9	8	12	13	68

CULTURAL DETAILS.

Competitor.	Timber.	No. of crops.	Rotation.	When ploughed.	Implement	Condition of land.	Depth.	Subsequent cultivation.	Variety.	When planted.	Rate of Seed.	Rate of Super.	Graded.	Disease.
							in				lb.	lb.		
Smith, C. & Sons	Jam, scrub and mallee	Since 1923	3 yrs Fallow, wheat stubble	End July	Disc ...	Good ...	4	Re-ploughed end Aug-Sept	Gluclub	1st week May ...	50	90	Yes	Takeall and Flagsmut.
Allan Bros ...	Gimlet ...	1st	2 yrs. Fallow, wheat	End June	Disc cultivator	Good	3	Springtyne cultivated Aug.	Gluclub	3rd week April	45	100	Yes	Trace Flagsmut and Takeall.
Farrall, F. C. & Sons	Salmon, gimlet and morrel	Since 1912 and 1921	3 yrs Fallow, wheat stubble	June	Mouldboard	Good	4	Disc cultivated Aug Springtyne cultivated end April and prior seeding	Gluclub	Mid May ...	51	103	Yes	Takeall.
Brown, S. A.	Salmon and gimlet	Since 1914	2 yrs. Fallow, wheat	June-July	Mouldboard	Good ...	3	Rigidtyne scarified Aug-Sept. Springtyne cultivated Sept-Oct. Rigidtyne scarified prior seeding	Gluclub	3rd week May	50	87	Yes	Takeall and Bunt.
Smith, C. & A. H.	Salmon, gimlet and morrel	"	3 yrs. Fallow, wheat stubble	June-July	Mouldboard	Good ...	3	Disc cultivated Aug. Springtyne cultivated Sept	Gluclb	2nd week May	40	90	...	Bunt.

Combined cultivator-drills were used by all competitors and all seed wheat was treated with copper carbonate.

DOODLAKINE-BAANDEE AGRICULTURAL SOCIETY.

The rainfall as recorded at Doodlakine during the year, the awards made, and the cultural details of the two competing crops in the Doodlakine-Baandee competition are tabulated hereunder:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Doodlakine ...	...	...	5	218	232	116	171	286	99	51	955	151	10	1,339

DOODLAKINE BAANDEE AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Prowse Bros. ...	Doodlakine...	Gluyas Early	30	8	7	14	13	72
Prowse, A. E. C. ...	Doodlakine ..	Gluyas Early	25	7	8	14	12	66

CULTURAL DETAILS.

Competitor	Timber.	No. of crops.	Rotation.	When ploughed.	Implement.	Condition of land.	Depth	Subsequent cultivations.	Variety.	When planted.	Rate of Seed.	Rate of Super.	Disease.
							in.				lb.	lb.	
Prowse, Bros. ...	Salmon, gimlet, mallee, and scrub	Since 1911	3 years. Fallow, Wheat, Stubble	End July	Disc ...	Good ..	4	Springtyne cultivated Sept., and prior seeding. Planted with combined cultivator drill.	Gluyas Early	End May ...	45	100	Takeall.
Prowse, A. E. C.	Gimlet ...	Since 1912	2 years. Fallow, Wheat	June	Disc ...	Good ...	4	Springtyne cultivated Sept. Harrowed after seeding. Planted with combined cultivator drill	Gluyas Early	End May ...	45	100	Takeall.

Both competitors graded and treated wheat with copper carbonate.

MERREDIN AGRICULTURAL SOCIETY.

The rainfalls, as recorded in the Merredin district, are as follow:—

—	Jan.	Feb.	Mar	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for year.
Merredin ...	...	8	2	225	236	128	253	268	107	68	1,060	42	40	1,386
Nukarni ...	...	5	6	257	225	119	193	204	102	72	915	62	21	1,266
Totadgin (Belka) ...	...	...	..	235	210	149	301	342	141	58	1,201	45	17	1,498
Nangeenan ...	...	54	4	191	218	115	197	257	81	44	912	24	40	1,225
S. Walgoolan ...	...	..	26	176	275	156	246	286	116	47	1,126	34	64	1,426
Koonadgin (Only Hope) ...	.	...	19	192	289	109	247	286	83	48	1,062			

The awards and cultural details are tabulated hereunder:—

MERREDIN AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address	Variety	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease 10 points	Freedom from Admixture. 15 points	Evenness of growth 15 points	Total. 100 points.
Cook, W. T. ..	S. Walgoolan	Merredin ...	35	9	8	13	13	78
Lambert, J. B. ..	Koonadgin .	Gluclub ..	32	9	8	12	13	74
Smallacombe, T. H	Nangeenan	Carrabin .	31	8	8	13	13	73
Merredin Meat Co	Merredin	Noongaar	27	8	8	13	13	69
Maughan Bros. ..	Nukarni	Gluclub ..	24	8	8	13	13	66
Cockram, W. H. ...	Nukarni	Gluyas Early	24	8	7	11	13	63
Teasdale, H. W. ..	Totadgin .	Nabawa .	18	7	7	13	12	57

CULTURAL DETAILS.

Competitor.	Timber.	No. of Crops.	Rotation.	When ploughed	Implement	Condition of Land.	Depth.	Subsequent cultivations.	Variety.	When planted.	Rate of Seed.	Rate of Super.	Disease.
							in				lb.	lb.	
Cook, W. T. ...	Gimlet, morrel and mallee	6	2 years. Fallow, Wheat	July	Disc cultivator	Good .	4	Springtyne cultivated Aug. Rigidtyne scarified Sept. Springtyne cultivated after rain end April. Planted with combined cultivator drill	Merredin	1st week May	43	112	Takeall, Flag Smut.
Lambert, J. B.. .	Gimlet ..	4	2 years. Fallow. Wheat	June	Disc cultivator	Good .	4	Springtyne cultivated Sept Planted with combined cultivator drill	Gluclub	Last week April	43	93	Traces Flag Smut, Takeall. and Bunt.
Smallacombe. T H	Salmon. gimlet and mallee	”	2 years Fallow, Wheat	July	Disc .	Good	3	Disc cultivated Sept. Springtyne cultivated prior seeding Planted with combined cultivator drill	Carrabin	Last week May	53	93	Takeall.
Merredin Meat Co.	Salmon, gimlet, teatree and mallee	”	3 years. Fallow. Wheat. stubble	June	Mouldboard	Good . .	3-4	Springtyne cultivated mid. Aug Rigid tyne scarified Sept Planted with combined cultivator drill	Noongaar	End May	50	90	Takeall, Flag Smut.
Cockram, W. H	Salmon. gimlet. morrel and teatree	Since 1911	3 years Fallow. Wheat. Stubble	July	Disc cultivator	Good .	4	Disc cultivated Aug. Harrowed Jan. Springtyne cultivated prior seeding. Harrowed after. Planted with a disc	Gluyas Early	3rd week May	50	75	Takeall, Bunt Flag Smut.
Teasdale, H. W	Gimlet and salmon	Since 1911	3 years. Fallow. Wheat, Oats	June-July	Mouldboard	Very hard	3-4	Rigid tyne scarified Sept. Planted with combined cultivator drill	Nabawa	3rd week April	43	90	Takeall.

ZONE 7.

Judge—G. L. THROSSELL, Agricultural Adviser.

Karlgarin Society, 5 Competitors; Kulin Society, 8 Competitors; Lake Grace Society, 4 Competitors. Total, 17 Competitors.

KARLGARIN AGRICULTURAL SOCIETY.

The rainfalls, as recorded at the Karlgarin centres during the year, are as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Karlgarin ...	...	. .	18	98	177	148	195	341	173	31	1,065			
Hyden Rock ...	...	5	17	122	123	150	152	293	165	46	929	26	24	1,123

The awards and cultural details are set out hereunder:—

KARLGARIN AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Ray, J. G. ...	N. Karlgarin	Gluyas Early	24	9	9	13	14	69
Grant, L. J. ...	Karlgarin ...	Nabawa ...	21	8	8	13	13	63
Clayton, R. G. ...	Hyden Rock	Nabawa ...	16	9	9	14	13	61
Biglin, E. J. ...	Karlgarin ...	Gluyas Early	17	8	8	13	12	58
Read, A. C. ...	Karlgarin ...	Nabawa ...	14	8	8	13	12	55

CULTURAL DETAILS

Competitor.	Timber.	No. of Crops.	Rotation.	When ploughed	Implement.	Condition of Land.	Depth.	Subsequent cultivations	Variety.	When Planted.	Rate of seed.	Rate of super.	Disease.
Ray, J. G. ...	Gimlet and mallee	4	4 years. Fallow, Wheat, Oats, Pasture	2nd week June	Disc ...	Good .	in. 4	Rigid tyne scarified Aug. and mid-Sept. and prior seeding with a disc	Gluyas Early	1st week May	lb. 39	lb. 60	Traces Flag Smut and Takeall.
Grant, L. T. ...	Salmon, gimlet and mallee	2	2 years. Fallow, Wheat	2nd week June	Disc cultivator	Good but weedy	3–4	Disc cultivated July. Planted with combined cultivator drill	Nabawa	End April ...	34	45	Takeall.
Clayton, R. G. ...	Salmon, morrel, mallee, merrit and teatree	3	2 years. Fallow, Wheat	June	Disc cultivator	Wet .	3	Disc cultivated Sept. Springtyne cultivated Oct. (dry). Planted with combined cultivator drill	Nabawa	End April ...	45	55	Takeall.
Biglin, E. J. ...	Morrel, salmon, merrit and gimlet	5	2 years. Fallow, Wheat	Early Aug.	Disc ..	Good .	3–4	Springtyne cultivated early Sept. Planted with combined cultivator drill	Gluyas Early	1st week May	45	50	Flag Smut, Bunt, and Takeall.
Read, A. C. ...	Salmon, gimlet and morrel	3	3 years. Fallow, Wheat, Stubble	End June	Disc cultivator	Good .	4	Springtyne cultivated Aug Planted with combined cultivator drill	Nabawa	2nd week June	45	90	Trace Takeall and Bunt.

All competitors graded and treated seed wheat with copper carbonate.

KULIN AGRICULTURAL SOCIETY.

The rainfalls, as recorded at the Kulin centres during the year, are as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Kulin	...	25	69	54	250	135	228	369	254	54	1,290	19	70	1,527
Kulin Rock ...	...	7	40	30	201	105	170	349	198	48	1,071	16	62	1,226
Gnarming ...	...	14	48	31	195	111	218	361	209	52	1,146	16	59	1,314
Jitarning (Deeplish) ...	...	23	37	71	208	128	202	351	289	59	1,237	13	47	1,428

The awards and cultural details are tabulated hereunder:—

KULIN AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield 50 points.	Freedom from Weeds. 10 points.	Freedom from Disease. 10 points.	Freedom from Admixture. 15 points.	Evenness of growth. 15 points.	Total. 100 points.
Freebairn, F. S. .	Jilakin	Gluclub .	31	9	8	13	13	74
Forsyth, Mrs. E. .	Jitarning	Waratah . .	28	9	8	14	13	71
Henderson, Mrs. F. H. R.	Gnarming	Merredin .	26	9	8	13	14	70
Trotter, A. W. . .	Kulin Rock	Free Gallipoli	25	9	8	13	14	69
Meikle, P.	Kulin Rock	Nabawa . .	23	8	8	12	12	63
Bowey & Baldock	Kulin . .	Nabawa .	21	9	8	13	12	63
Nichols, R. ...	Kulin Rock	Merredin ..	20	9	7	14	12	62
Forsyth, A. B. . .	Jitarning .	Hard Federation	20	8	8	13	13	62

CULTURAL DETAILS.

Competitor.	Timber.	No. of Crops.	Rotation.	When ploughed	Implement	Condition of Land.	Depth.	Subsequent cultivations.	Variety.	When planted.	Rate of Seed.	Rate of Super.	Disease.
							in.				lb.	lb.	
Freebairn, F. S.	Gimlet and morrel	?	3 years. Fallow, Wheat, Oats	Mid-Aug.	Disc ..	Wet .	4	Rigid tyne scarified end Sept., part in early May. Planted with combined cultivator drill	Gluclub	Mid-May ..	60	90	Traces Flag Smut and Takeall.
Forsyth, Mrs. E.	York gum, salmon and jam	5	3 years out. Fallow, Wheat	End June	Mouldboard	Good ..	3	Disc cultivated dry April and 1st week May. Planted with combined cultivator drill	Waratah	Mid-May .	40	100	Traces Flag Smut and Takeall.
Henderson, Mrs. F. H. R.	Salmon, morrel	?	3 years. Fallow, Wheat Oats	...	.	...	..	.. ..	Merredin	Last week June	52	60	Flag Smut, Bunt.
Trotter, A. W. ...	Jam ...	6	2 years. Fallow, Wheat	June	Disc .	Good ...	4	Reploughed Aug. Planted with combined cultivator drill	Free Gallipoli	Mid-May ...	60	90	Flag Smut and Bunt.
Meikle, P. ..	Gimlet .	[illegible]	3 years. Fallow, Wheat Oats	July-Aug.	Mouldboard	Good	3	Disc cultivated end Sept. Planted with combined cultivator drill	Nabawa	1st week May	40	90	Takeall and Bunt.
Bowey and Baldock	Salmon and mallee	2	2 years Fallow, Wheat	Mid-Aug.	Scarifier	Good	2-3	None Planted with combined cultivator drill	Nabawa	2nd week May	50	77	Takeall and Bunt.
Forsyth, A. B. .	Salmon, morrel, York and jam	3	Out 2 years Fallow, Wheat	Early June	Mouldboard	Good	3	Disc cultivated first week May. Planted with combined cultivator drill	Hard Federation	2nd week May	40	100	Takeall and Flag Smut.
Nichols, R. ..	Salmon .	2	2 years. Fallow, Wheat	July	Disc ..	Good	4	Disc cultivated end Aug Springtyne cultivated prior to seeding Planted with a disc	Merredin	Mid-May .	50	90	Flag Smut, Mildew, Takeall.

All seed wheat graded and treated with copper carbonate.

LAKE GRACE AGRICULTURAL SOCIETY.

The rainfalls, as recorded at the Lake Grace centres during the year, are as follow:—

—	Jan.	Feb	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Lake Grace ...	...	37	36	65	223	149	183	379	229	45	1,208	67	46	1,450
Burngup (Dulwich Hill) ...	..	26	22	36	177	88	154	295	188	65	967	11	51	1,113

The awards and cultural details are set out hereunder:—

LAKE GRACE AGRICULTURAL SOCIATY.

Judge: G. L. THROSSELL, Agricultural Adviser.

Competitor.	Address	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of Growth. 15 points	Total. 100 points.
Collinson & Fleay...	Burngup ...	Gluclub ...	29	9	8	13	14	73
Bishop, S. H. ...	Lake Grace	Waratah ...	18	8	8	13	13	60
Bishop, H. F. ...	Lake Grace	Nabawa ...	19	7	7	13	12	58
Fry, E. H.... ...	North Lake Grace	Nabawa ..	18	7	7	12	12	56

CULTURAL DETAILS.

Competitor.	Timber.	No. of years cropped.	Rotation.	When ploughed	Implement	Condition of land.	Depth.	Subsequent cultivations.	Variety	When planted.	Rate of Seed	Rate of Super.	Seed treatment.	Graded.	Diseases.
Collinson & Fleay	Morrel, yorrel, salmon and gimlet	2	3 years. Fallow, Wheat, Oats	Aug.	Disc .	Good	in. 4	Springtyne cultivated prior to seeding Planted with a disc	Gluclub	End May .	lb. 60	lb 90	Copper carbonate	..	Bunt Trace Takeall.
Bishop, S. H.	Salmon, gimlet and yorrel	Since 1911	3 years. Fallow. Wheat. Stubble	July	Mouldboard	Good	4	Disc cultivated Aug Springtyne cultivated Sept. Disc cultivated prior seeding Planted with disc	Waratah	1st week June	45	90	Copper carbonate	Yes	Takeall.
Bishop, H. F.	Salmon, blackbutt, gimlet and and boree	Since 1920	4 years. Fallow. Wheat, Wheat, Oats	Aug.	Disc cultivator	Wet	3	Harrows behind plough. Planted with a combined cultivator drill	Nabawa	Mid-April	45	93	Copper carbonate	Yes	Takeall.
Fry, E. H. ..	Salmon and morrel	4	3 years Fallow. Wheat Oats	June-July	Mouldboard	Good	4	Springtyne cultivated Aug Cross harrowed Sept Planted with combined cultivator drill	Nabawa	2nd week April	50	112	Copper carbonate	Yes	Takeall.

ZONE 8.

Judge—A. S. WILD, B.Sc.(Agric.), Agricultural Adviser.

Royal Society, 5 Competitors; Wickepin Society, 6 Competitors; Nyabing Society, 3 Competitors; Gnowangerup Society, 15 Competitors. Total, 29 Competitors.

ROYAL AGRICULTURAL SOCIETY.

Zone 8.

The following are the rainfalls as recorded at the centres where the crops entered direct with the Royal Agricultural Society were located:—

—	Jan.	Feb	Mar.	Apl	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July	Aug	Sep.	Oct.	Total.			
Borden	...	20	112	89	194	126	117	301	277	43	1,058	40	60	1,379
Gnowangerup ..	..	13	135	117	186	145	172	295	335	37	1,170	9	74	1,518
Quairading ..	.	..	21	52	284	141	238	418	193	41	1,315	18	94	1,500
S. Caroling (Woodstock) ..		.	27	48	217	118	149	298	264	47	1,093	6	109	1,283

The awards and cultural details are tabulated below:—

ROYAL AGRICULTURAL SOCIETY.

Judge: A. S. WILD, Agricultural Adviser.

Competitor	Address	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Murray, W. G. ..	Borden ..	Yandilla King	39	9	9	13	14	84
Lohoar, J. P. & Sons	S. Quairading	Gluclub .	36	9	8	13	13	79
Richards, A. .	S. Caroling .	Nabawa ..	34	9	8	14	13	78
Wellard & Wellard	Gnowangerup	Nabawa .	35	8	9	13	13	78
Taylor, H. E. & Sons	Quairading	Gluclub ..	33	8	8	13	13	75

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Condition of Land.	Implement.	Depth.	Subsequent cultivations.	Variety	Planted.	Rate of Seed.	Rate of Super.	Disease.
						in.				lb.	lb.	
Murray, W. G. ...	Old land ...	York gum, morrel, and jam	Aug.	Hard ...	Mouldboard	3	Springtyne cultivated in Oct., again in Nov., and again in March. Planted with combined cultivator drill	Yandilla King	Mid-May ...	49	112	Trace Takeall.
Lahoar, J. & Sons	(?)	Gimlet and salmon	Aug.	Fair .	Mouldboard	4–5	Springtyne cultivated in Oct. and again just before seeding	Gluclub	Late May . .	45	90	Trace of Take-all. Trace of Bunt.
Richards, A. ...	Old land	Yorkgum, morrel and salmon	July	Good	Mouldboard	3½	Springtyne cultivated in Sept., again early in Oct., and again just before seeding	Nabawa	2nd week May	52	125	Trace of Take-all. Trace of Flagsmut.
Wellard & Wellard	Old land	Salmon, York-gum, manna-gum and morrel	June	Good .	Disc ...	3	Disced 2in. deep in Oct. Springtyne cultivated in April, again in May. Planted with combined cultivator drill	Nabawa	Early June...	60	90	Trace of Take-all
Taylor, H. E. & Sons	Old land	Gimlet and salmon	July	Good .	Rigidtyne scarifier	3	Rigidtyne scarified 2¼in. deep in Sept. and again just before seeding. Planted with combined cultivator drill	Gluclub	Late May ...	50	100	Trace of Flying Smut and traces Takeall.

All competitors graded and treated seed with copper carbonate.

WICKEPIN AGRICULTURAL SOCIETY.

The rainfalls, as recorded during the year at the Wickepin centres, are as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Tinkurrin (Tovil) ...	...	29	40	111	243	150	184	391	432	25	1,425	30	115	1,750
Malyalling ...	...	3	14	113	241	138	173	338	326	37	1,253	74	52	1,509
Wickepin ...	...	6	22	99	288	171	287	477	386	13	1,622	69	46	1,864

The awards made and the cultural details of the competing crops are set out below:—

WICKEPIN AGRICULTURAL SOCIETY.

Judge: A. S. WILD, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture 15 points	Evenness of growth. 15 points	Total. 100 points.
Murray, A.... ...	Tinkurrin ..	Canberra ...	33	9	7	14	13	76
Hosken Bros. ...	Dorakin .	Gallipoli ...	31	9	9	13	13	75
Dalton, L. C. ...	Malyalling ...	Rajah ...	28	8		13	13	71
Cook & Hutton ...	Dorakin ...	Gallipoli ...	27	8	9	13	13	70
Fleay, E. G. ...	Wickepin ...	Gluclub ...	28	9	7	12	13	69
Lewis, A. R. & Sons	86 Gate ..	Hard Federation	24	9	8	14	13	68

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth	Subsequent cultivation.	Variety.	Planted.	Rate of Seed	Rate of Super.	Seed treatment.	Graded.	Disease.
Murray, A. ...	2nd crop	Salmon, yorkgum and morrel	July	Fair	Mouldboard	in 4	Disced 2in. deep at end of Oct. Springtyne cultivated early in May Planted with combined cultivator drill. Harrowed just after	Canberra	Late May ..	lb. 55	lb. 90	No	Yes	Traces of Bunt, Take-all and Flying Smut
Hosken Bros.	Old land	Salmon, morrel, and yorkgum	July	Good	Mouldboard	3–4	Springtyne cultivated Sept., and portion again in Oct. Planted with combined cultivator drill attached with light harrows	Gallipoli	2nd week May	60	60	Copper carb.	Yes	Trace of Take-all.
Dalton, L. C.	Old land	Jam and yorkgum	Sept.	Varying	Mouldboard	3½	Springtyne cultivated in Oct., and again just before planting. Drag harrows behind drill	Rajah	Late May .	60	112	Copper carb.	Yes	Trace of Take-all.
Cook and Hutton	Old land	Jam, yorkgum and morrel	Aug.	Wet	Mouldboard	3–4	Springtyne cultivated in Sept., again in Oct., and planted with combined cultivator drill	Gallipoli	Late April	60	90	Formalin	Yes	Trace of Take all.
Fleay, E. S. ...	4th crop	Morrel, Salmon, yorkgum and whitegum	July	Good	Mouldboard	4	Disced 2in. deep just before seeding. Planted with combined cultivator drill	Gluclub	Late April, and early May	50	61	Copper carb	Yes	Traces of Takeall, Flying Smut and Bunt
Lewis, A. R. & Sons	Old land	Salmon, yorkgum and jam	Aug.	Fair	Disc	3½	Springtyne cultivated just before planting and harrowed just after	Hard Federation.	Late May .	45	90	Copper carb.	Yes	Trace of Take-all.

NYABING AGRICULTURAL SOCIETY.

The rainfalls, as recorded at Nyabing during the year, were as follow:—

—	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Nyabing	...	11	69	90	267	135	243	383	359	24	1,411	39	42	1,662

The awards and cultural details are tabulated hereunder:—

NYABING AGRICULTURAL AREA.

Judge: A. S. WILD, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
Slee, E. J. W. ...	Boongadoo...	Major ...	25	8	8	13	13	67
Charlsley, H. J. ...	Nyabing ...	Nabawa ...	24	7	8	13	13	65
Sargent, A. McD. ...	Boongadoo...	Major ...	19	7	7	13	12	58

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth	Subsequent cultivations	Variety.	Planted.	Rate of Seed	Rate of Super	Seed treatment.	Graded.	Disease.
						in.				lb.	lb.			
Slee, E. J. W.	5th crop	Yorkgum, jam, and sheoak	Sept.	Boggy in patches	Disc	2½	Disced 2in deep in Oct., and planted with combined cultivator drill	Major	Mid May ..	45	90	Formalin	Yes	Traces of Takeall and trace of Flying Smut
Charlsley, H. J.	Old land	Salmon-gum, morrel, and manna gum	July	Wet	Disc	4–5	Springtyne cultivated Oct., and again just before seeding	Nabawa	Mid May ...	35	70	No	Yes	Trace of Takeall and trace of Bunt.
Sargent, A. McD.	Old land	Morrel salmon, and jam	July-Sept.	Hard in patches	Disc	3½	Disced 2½in. deep just after ploughing. Planted with combined plough (disc) drill	Major	1st week May	50	85	Copper carb.	Yes	Takeall, and traces of Bunt, Flag Smut and Flying Smut.

GNOWANGERUP AGRICULTURAL SOCIETY.

The following table shows the rainfalls as recorded at Gnowangerup during the year:—

——	Jan.	Feb.	Mar	Apl	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for year.
Gnowangerup ...	...	13	135	117	186	145	172	295	335	37	1,170	9	74	1,518

The awards and cultural details are tabulated hereunder:—

GNOWANGERUP AGRICULTURAL SOCIETY.

Judge A. S. WILD, Agricultural Adviser.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds 10 points	Freedom from Disease 10 points	Freedom from Admixture 15 points	Evenness of growth 15 points	Total. 100 points.
Beeck, H. O. ...	Gnowangerup	Yandilla King	42	9	8	13	14	86
Cockram, C. E. ...	Pallinup ..	Yandilla King	40	8	9	14	14	85
Formby, R. & Co., Ltd	Gnowangerup	Yandilla King	38	9	9	14	13	83
McDonald, J ...	Gnowangerup	Yandilla King	36	9	10	14	14	83
Ball, J. L. ..	Gnowangerup	Bena	37	9	9	13	13	81
Stewart, W. B. ..	Gnowangerup	Yandilla King	35	9	9	14	14	81
Tymms, H. O.	Gnowangerup	Yandilla King	38	8	9	13	13	81
White, R. H. ..	Pallinup .	Yandilla King	34	9	9	14	14	80
Schneider Bros. ..	Gnowangerup	Nabawa	35	8	8	13	13	77
Chambers, E. ..	Pallinup	Yandilla King	29	9	9	14	13	74
Garnett, J. ...	Gnowangerup	Yandilla King	31	8	9	13	13	74
Taylor, C.	Pallinup ..	Yandilla King	29	9	9	14	13	74
Wright, E. H. ...	Pallinup	Yandilla King	29	8	9	14	13	73
Johnston, Alf. ..	Gnowangerup	Nabawa .	27	8	9	14	13	71
Whyatt, C. A. ...	Pallinup ...	Yandilla King	28	9	7	14	12	70

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Condition of land.	Implement.	Depth.	Subsequent cultivations	Variety	Planted	Rate of Seed	Rate of Super.	Seed Treatment.	Graded.	Disease.
Beeck, H. O.	Old land	Salmon and morrel	April, 1930	Good ...	Rigidtyne scarifier	in. 2½	Springtyne cultivated May, 1930 Rigidtyne cultivated Aug., 1930, and again May, 1931. Planted with combined cultivator drill and harrowed immediately after	Yandilla King	Mid-May	lb. 50	lb. 80	Copper carbonate	Yes	Trace Take-all and Flying Smut.
Cockram, C. E.	Old land	Yorkgum, salmon and morrel	July	Fair .	Mouldboard	3	Springtyne cultivated in Oct., again in Mar and again in April	Yandilla King	Mid-May	48	100	Copper carbonate	Yes	Trace Takeall.
Formby, R., & Co., Ltd.	Old land	Chiefly salmon	Early July	Good	Mouldboard	3½	Harrowed Aug., Springtyne cultivated early Sept., and again in April Planted with combined cultivator drill	Yandilla King	Mid-May	45	90	Copper carbonate	Yes	Trace Flying Smut.
McDonald, J.	Old land	Salmon and Yorkgum	July and Aug., 1929	Good	Mouldboard	3½	Springtyne cultivated Oct., 1929, and again Mar., 1930 Mouldboard ploughed 2in. deep Aug., 1930 Springtyne cultivated, Oct., 1930, and again Mar., 1931. Planted with combined cultivator drill and harrowed immediately after	Yandilla King	Mid-May	55	90	Copper carbonate	Yes	
Ball, J. L. ...	3rd crop	Morrel and salmon	Early July	Good .	Mouldboard	3	Disced 2in deep early Sept. Springtyne cultivated Sept., and before seeding	Bena	Mid-May .	45	90	Copper carbonate	Yes	Trace of Take-all.
Stewart, W. B.	3rd crop	Yorkgum and morrel	Early Aug.	Good	Mouldboard	3	Springtyne cultivated early Sept., again in March, and again in April. Planted with combined cultivator drill	Yandilla King	3rd week May	53	150	Copper carbonate	Yes	Trace of Take-all.
Tymms, H. O.	1st crop in 10 years	Yorkgum and morrel	July	Good	Mouldboard	4	Disced 2in. deep Feb., and again in front of drill, harrowed just after drill	Yandilla King	3rd week April	60	60	Copper carbonate	Yes	Trace Takeall and Flying Smut.

CULTURAL DETAILS—*continued.*

Competitor.	No. of years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Seed Treatment.	Graded.	Disease.
White, R. H.	Old land	Yorkgum and morrel	Aug	Good .	Mouldboard	in. 4	Springtyne cultivated twice in Oct., again early in Nov., and again April. Planted with combined cultivator drill	Yandilla King	3rd week May	lb. 55	lb. 100	Copper carbonate	Yes	Trace Takeall.
Schneider Bros.	?	Yorkgum, salmon and morrel	Early Aug.	Little wet	Mouldboard	3	Springtyne cultivated Sept. Harrowed in March Springtyne cultivated in Mar. Planted with combined cultivator drill	Nabawa	End May .	64	93	Copper carbonate	Yes	Trace Takeall and Flying Smut.
Chambers, E.	6th crop	Yorkgum, whitegum, and yate	Aug.	Good	Mouldboard	4	Springtyne cultivated twice in spring and again in autumn. Planted with combined cultivator drill	Yandilla King	3rd week May	50	80	No	Yes	Trace Takeall.
Garnett, J .	12 years	Yorkgum, morrel, mallet and whitegum	Aug..	Slightly dry	Mouldboard	3	Cultivated twice with duckfoot cultivator and twice harrowed	Yandilla King	1st week May	56	90	Bluestone	Yes	Trace Takeall.
Taylor, C. ...	2nd crop	Yorkgum, black mallee and morrel	Early June	Excellent	Disc chiefly, small portion mouldboard	3	Portion springtyne cultivated in Sept., and again in Oct. Whole skim ploughed 2in. deep with mouldboard in Mar. Springtyne cultivated in April. Planted with combined cultivator drill	Yandilla King	Mid-May .	60	93	Vitrolene	Yes	Trace Takeall.
Wright, E. H.	6th crop	Yorkgum, morrel, whitegum	July	Good ..	Mouldboard	3	Springtyne cultivated in Sept., and again in Mar. Planted with combined cultivator drill	Yandilla King	Early May ..	60	80	Formalin	Yes	Trace Takeall.
Johnston, Alf	Old land	Salmon, morrel, sheoak, mannagum and whitegum	Aug	Good ..	Mouldboard	3	Rigidtyne cultivated and harrowed in spring. Rigidtyne cultivated just before seeding and harrowed just after	Nabawa	2nd week June	60	83	Copper carbonate	Yes	Trace Takeall.
Whyatt, C. A.	6th crop	Morrel and Yorkgum	Aug.	Good ...	Mouldboard	3½–4	Springtyne cultivated in Sept., Oct., Mar., April, and again in front of drill	Yandilla King	Mid-May ...	45	60	No	Yes	Takeall.

ZONE 9.

Judge—L. G. SEINOR, Manager, Experiment Farm, Salmon Gums. Southern Mallee Society, 23 Competitors.

SOUTHERN MALLEE AGRICULTURAL SOCIETY.

The only entries received in Zone 9 were those of the Southern Mallee Agricultural Society. The rainfalls recorded at the centres concerned are as follow:—

——	Jan.	Feb.	Mar	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Kumarl (Coggeshall)	5	175	3	75	271	206	159	374	96	78	1,184	99	...	1,541
Grass Patch ...	13	123	23	105	298	306	171	393	139	81	1,388	100	14	1,766
Scaddan	24	80	23	148	358	360	130	418	154	94	1,514	242	22	2,053
Red Lake ...	6	160	13	76	259	262	170	371	108	82	1,252	198	9	1,714
Salmon Gums ...	..	173	3	85	232	232	156	381	88	99	1,188	90	10	1,549

The awards made and the cultural details of the competing crops are tabulated hereunder:—

SOUTHERN MALLEE AGRICULTURAL SOCIETY, 1931

ZONE 9.

Judge L. G. SEINOR, Manager, Experimental Farm, Salmon Gums

Competitor.	Address	Variety.	Yield. 50 points	Freedom from Weeds 10 points	Freedom from Disease 10 points	Freedom from Admixture. 15 points	Evenness of growth. 15 points	Total. 100 points.
J. O'Brien . ..	Kumarl ...	Nabawa ..	34	9	9	12	13	77
T. Haywood ...	E. Dowak ...	Gluyas Early	28	9	9	14	14	74
R. B. Johns ...	Grass Patch	Ford ...	26	9	9	14	14	72
N. Norton	East Salmon Gums	Nabawa . .	26	9	9	14	13	71
W. Barry	W. Dowak	Nabawa ...	26	9	9	14	13	71
R Swan	East Salmon Gums	Nabawa . .	26	9	9	12	14	70
A. Guest	Beete ...	Gluyas Early	28	8	8	12	13	69
C. Flintham ...	Scaddan ...	Gluyas Early	24	8	8	14	13	67
Thomas Bros. ...	East Salmon Gums	Nabawa ...	25	8	8	13	12	66
Grigg Bros. ...	Scaddan ...	Gluyas Late	25	8	7	13	13	66
E. Prince	Kumarl . .	Bena ...	23	9	8	12	13	65
J. A. Webster ...	Treslove . .	Nabawa ..	23	9	8	13	12	65
A. Thomson ...	Red Lake ..	Gluyas Early	23	7	8	13	13	64
J. McCosh	Kumarl ...	Nabawa . .	19	9	8	14	13	63
W. F. McCrea ...	East Salmon Gums	Gluyas Early	22	8	9	12	12	63
J. Thomas ...	Kumarl . .	Gluyas Early	23	9	9	12	10	63
C. Berryman ...	Beete ..	Ford ...	20	8	8	12	14	62
N. Donovan ...	Kumarl ...	Nabawa ...	22	8	8	12	10	60
W. P. Southern ...	Scaddan ..	Nabawa ...	21	8	7	12	12	60
H. Sharpe	Treslove ...	Nabawa ...	18	8	7	13	12	58
W. Lunnon ...	Red Lake ...	Nabawa ...	19	6	7	13	13	58
N. Sedgwick ...	Red Lake ...	Nabawa ...	18	7	8	12	12	57
D. R. Richie ...	Grass Patch	Nabawa ...	16	7	6	13	10	52

J. O'Brien's Winning Crop of "Nabawa," No. 9 Zone.
Calculated yield 34 bushels

T. Haywood's crop of "Gluyas Early," second prize winner, No. 9 Zone.
Calculated yield 28 bushels.

CULTURAL DETAILS.

Competitor.	Years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth	Subsequent cultivations	Variety.	Planted.	Rate of Seed.	Rate of Super.	Graded.	Disease.
						in.				lb.	lb.		
O'Brien, J. ...	1st	Silver bark, black mallee	June	Good	Disc	3-4	Springtyne cultivated in Oct. and Nov.	Nabawa	2nd week April	35	80	Yes	
Haywood, T. ...	1st	Light silver salmon	June	Good	Disc	4	Cultivated March, Harrowed April ahead of seeding, also after seeding	Gluyas Early	Last week April	30	83	Yes	
Johns, R. B. ..	1st	Light mallee and silver bark	June	Good	Disc	3-4	Cultivated ahead of drill	Ford	Last week April	45	90	No	
Morton, N. ...	1st	Silver bark and light mallee	Jan., 1929	Dry	Disc	3-4	Cross sundercut, Aug., 1929, also ahead of drill	Nabawa	2nd week May	40	80	Yes	
Barry, W. ..	1st	Salmon gum silver bark	June	Good	Disc	4	Harrowed Sept. and Oct.	Nabawa	End April	44	80	No	
Swan, R. ...	1st	Gimlet, mallee silver bark	July	Good	Disc	4	Harrowed ahead of drill and after drill	Nabawa	Mid April	40	85	Yes	
Guest, A. ...	1st	Silver bark and morrel	June	Good	Disc	4	Cultivated Sept. Harrowed ahead of drill	Gluyas Early	2nd week May	40	90	Yes	
Flintham, C. ...	1st	Jamma scrub and mixed mallee	May-June	Good	Disc	4	Cross ploughed July and Aug., twin disc	Gluyas Early	Early May	55	83	No	
Thomas Bros. ..	1st	Silver bark and mallee	June	Good	Disc	4	Cross ploughed Sept. and ahead of drill	Nabawa	1st week April	36	83	No	
Grigg, Bros. .	1st	Mallee	June-July	Good	Disc	4	Cross ploughed ahead of drill	Late Gluyas	Early May	50	112	Yes	Rust.
Prince, E. ...	1st	Whipstick, gimlet and black mallee	June	Good	Disc	3-4	Springtyne cultivated in Oct. and ahead of drill	Bena	April	38	83	Yes	Trace Flying Smut on foreign wheat
Webster, J. A. ..	1st	Silver bark and light mallee	July	Good	Disc	3-4	Cross ploughed ahead of seeding	Nabawa	April	48	83	No	Trace Rust

CULTURAL DETAILS—*continued.*

Competitor.	Years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Graded.	Disease.
						in.				lb.	lb.		
Thomson, A. ...	...	Silver bark and light mallee	..	...	..	..	... .	Gluyas Early	...	..	...	...	Trace Rust
McCosh, J. ...	1st	Dundas blackbutt	June-July	Good ..	Disc .	3	Springtyne cultivated Oct., also ahead of drill	Nabawa	2nd week April	39	80	Yes	
McCrea, W. F. ...	1st	Gimlet, salmon gum and morrel	June	Good .	Disc	4	Springtyne cultivated ahead of drill	Gluyas Early	2nd week May	45	78	Yes	
Thomas, J. ...	1st	Salmon gum, black mallee and morrell	July	Good .	Mould-board	4	Springtyne cultivated Oct.	Gluyas Early	1st week May	30	75	Yes	
Berryman, C. ...	1st	Blackbutt, gimlet and black mallee	July	Good ..	Mould-board	4	Springtyne cultivated Sept. Harrowed ahead of drill	Ford	3rd week April	30	75	Yes	
Donovan, M. ...	1st	Silver bark and mallee	June-July	Good ...	Disc ...	4	Springtyne cultivated in Oct.	Nabawa	2nd week April	40	85	Yes	
Southern, W. P.	1st	Mallee type	July-Aug.	Good ...	Disc ...	4	Cross ploughed in April, ahead of seeding	Nabawa	2nd week April	45	85	No	Trace Smut and Rust.
Sharp, H. ...	Old land	Light mallee	Sept.	Good ...	Disc ..	4	Cross ploughed in March	Nabawa	3rd week April	48	73	No	Trace Rust.
Lunnon, W. ...	Old land	Silver bark, mallee and scrub	June	Good ...	Disc ..	3	Cross ploughed Nov., Springtyne cultivated ahead of seeding	Nabawa	2nd week May	45	90	Yes	Trace Smut.
Sedwick, N. ...	1st	Silver bark and gimlet	Aug.	Good .	Disc .	3	Cross ploughed before seeding	Nabawa	2nd week April	40	80	No	Trace Rust.
Richie, D. R. ...	Old land	Silver bark and light mallee	June-July	Good ...	Disc .	4	Cross ploughed Sept., and again ahead of seeding	Nabawa	1st week May	45	90	No	Smut. Trace Rust.

All competitors treated seed with copper carbonate.

ROYAL AGRICULTURAL SOCIETY—ZONE CHAMPIONSHIP AWARDS.

Representatives from District Agricultural Societies' Competitions and entries received direct by Royal Agricultural Society.

Competitor.	District.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth	Total.
ZONE 1.—Judge: I Thomas, Superintendent of Wheat Farms.									
				50 pts.	10 pts.	10 pts.	15 pts	15 pts	10 pts.
Hebiton, J. K., Sr.	Three Springs	Three Springs	Merredin ..	40	8	8	13	14	83
Forrester, J. K.	Carnamah ...	Royal ..	Nabawa	37	8	8	13	14	80
Bothe, B. D. ...	Coorow .	Royal .	Bena ...	35	8	8	13	14	78
Rudduck, A. .	Coorow ..	Royal .	Nabawa ..	32	9	8	14	14	77
Cumming, A. S.	Carnamah .	Royal	Merredin .	35	7	8	12	14	76
Durack, P. M...	Arrino	Three Springs	Merredin ..	34	8	8	11	13	74
Hilfers & Robertson	Watheroo ..	Royal .	Waratah	32	8	7	13	13	73
Green, J. W. ...	Carnamah ..	Royal ..	Merredin ..	33	7	7	13	13	73
ZONE 2.—Judge. F L. Shier, Agricultural Adviser.									
Moore, T ...	Indarra .	Royal	Merredin ...	30	9	9	13	14	75
Porter, F. A. .	Ajana ..	Royal	Geeralying .	22	9	9	13	14	67
ZONE 3.—Judge. R P. Roberts, Agricultural Adviser									
Woodfield, N....	Goomalling ..	Royal ..	Gluclub ...	35	8	8	13	12	76
Jones, W W.	Cowcowing .	Royal .	Nabawa	30	9	9	13	14	75
ZONE 4.—Judge: R. P Roberts, Agricultural Adviser.									
Landsell, G. ...	Mukinbudin ..	Nungarin .	Gluyas Early	31	8	9	13	14	75
Creagh Bros. ...	Kwelkan .	Nungarin .	Gluyas Early	30	9	7	14	13	73
Hopwood, B. W. G.	Bencubbin .	Mt Marshall	Bencubbin ..	28	9	9	13	13	72
Thomson, M. ...	N. Bencubbin	Mt Marshall	Nabawa .	24	8	9	12	14	67
ZONE 5.—Judge: G. L Throssell, Agricultural Adviser.									
Cook, W T. ..	S. Walgoolan	Merredin	Merredin	35	9	8	13	13	78
Smith, C. & Sons	Yarding	Bruce Rock	Gluclub	32	9	9	13	14	77
Allen Bros ..	Central Kunminin	Bruce Rock	Gluclub	31	9	9	12	14	75
Lambert, J. B. ..	Koonadgin	Merredin .	Gluclub ..	32	9	8	12	13	74
Prowse Bros. ..	Doodlakine ..	Doodlakine-Baandee	Gluyas Early	30	8	7	14	13	72
Prowse, A. E. C	Doodlakine .	Doodlakine-Baandee	Gluyas Early	25	7	8	14	12	66
ZONE 7.—Judge. G L. Throssell, Agricultural Adviser.									
Freebairn, F S.	Jilakin	Kulin	Gluclub .	31	9	8	13	13	74
Collinson & Fleay	Burngup .	Lake Grace	Gluclub	29	9	8	13	14	73
Forsyth, Mrs. E.	Jitarning .	Kulin	Waratah	28	9	8	14	13	71
Ray, J. G. ..	N. Karlgarin	Karlgarin .	Gluyas Early	24	9	9	13	14	69
Grant, L. J. .	Karlgarin .	Karlgarin	Nabawa .	21	8	8	13	13	63
Bishop, S. H....	Lake Grace .	Lake Grace..	Waratah ...	19	7	7	13	12	60
ZONE 8. Judge. A S Wild, Agricultural Adviser									
Beeck, H. O. ..	Gnowangerup	Gnowangerup	Yandilla King	42	9	8	13	14	86
Cockram, C. E....	Pallinup .	Gnowangerup	Yandilla King	40	8	9	14	14	85
Murray, W. G....	Borden	Royal	Yandilla King	39	9	9	13	14	84
Lohoar, J. P. & Sons	S. Quairading	Royal ..	Gluclub .	36	9	8	13	13	79
Richards, A. ...	S Caroling .	Royal	Nabawa ..	34	9	8	14	13	78
Wellard & Wellard	Gnowangerup	Royal .	Nabawa ..	35	8	9	13	13	78
Murray, A. ..	Tinkurrin ..	Wickepin ...	Canberra ...	33	9	7	14	13	76
Hosken Bros. ...	Dorakin ...	Wickepin	Gallipoli ...	31	9	9	13	13	75
Taylor, H. E. & Sons	Quairading .	Royal ...	Gluclub ..	33	8	8	13	13	75
Slee, E. J. W. ...	Boongadoo ..	Nyabing ...	Major ..	25	8	8	13	13	67
Charlsley, H. J.	Nyabing ...	Nyabing	Nabawa ..	24	7	8	13	13	65
ZONE 9.—Judge: L. G Senior, Manager, Experiment Farm, Salmon Gums									
O'Brien, J. ...	Kumarl ...	S. Mallee ...	Nabawa ...	34	9	9	12	13	77
Haywood, T. ...	E. Dowak ...	S Mallee .	Gluyas Early	28	9	9	14	14	74

OBJECTS OF THE COMPETITION.

The object of the competitions is the improvement of the standard of wheat farming methods practised throughout the Wheat Belt. A spirit of healthy rivalry is engendered, and competitors and others set themselves to follow those more successful than themselves. The methods practised by all the competitors are tabu-

lated, the good farmers of the State receive recognition of their ability, and consequently a standard of practical wheat farming is established. It is demonstrated that where recommended methods are employed, reasonable success follows. The competitions also afford the officers of the Department of Agriculture opportunities to come into personal contact with the farmers.

THE SEASON.

The 1931 season was favourable for weed growth and disease development, and demonstrated the necessity for arranging farming operations to control such conditions.

Owing to the scanty rainfall during the autumn months, difficulty was experienced in preparing a desired seed bed and destroying weed growth prior to planting. The result was that much crop was planted on fallow which was dry and contained weed seeds.

Heavy rains fell during the first fortnight in May. These, however, were followed by a dry period which lasted to the end of the first week in June. This caused anxiety regarding the germination. However, though late, the crops came away fairly well after the June rains.

Heavy successive frosts during June and July retarded crop growth, but quicker growth was made with the warmer conditions from the latter end of August. With the advent of warmer weather, also, diseases appeared. Of these, Take-all was the most prevalent. The winter rains, in most districts, were slightly below the average.

Towards the end of the growing season the seasonal rains in the Eastern districts terminated early and abruptly.

ENTRIES.

The total number of crops competing for the Zone Championship Awards in the different zones was 110.

Entries were received from 13 district Agricultural Societies, and 15 entries were received direct by the Royal Agricultural Society. In addition, local competitions were conducted by the Dalwallinu, Kukerin, Bruce Rock, and Phillips River Agricultural Societies, and also by the Karloning Primary Producers' Association. These local competitions included 39 competitors, making a total of 149 crops inspected in all

The following table shows the progress of the competition since its inception in 1921:—

Year.	No. of District Agricultural Societies competing.	No. of Competitors.	Average Yield of Competitors.	Average Yield for State.
			bush.	bush.
1921	...	15	25	10·4
1922	...	32	24	8·9
1923	12	82	29	11·4
1924	15	70	31	12·8
1925	13	59	22·5	9·7
1926	11	99	24·5	12·0
1927	10	100	26·9	12·1
1928	13	114	22·5	10·1
1929	12	156	21·7	11·0*
1930	15	165	27·4	13·3
1931	13	110	27·4	*11·6

* Estimate. District Agricultural Societies did not participate until 1923.

VARIETIES.

The standard midseason maturing variety, Nabawa, was planted by 31 of the 110 competitors. Fifteen planted the standard early variety, Gluyas Early, and thirteen the standard late variety, Yandilla King. The varieties, Gluclub and Merredin, were planted by 13 and 12 competitors respectively; Waratah, Gallipoli, and Bena each by three; Major, Hard Federation, Carrabin, Geeralying, and Ford by two, and Canberra, Rajah, Bencubbin, S.H.J., Gluyas Late, Noongaar, and Federation by one.

Three zone championships were won with the variety Merredin; two with Gluclub; and one each with the varieties Gluyas Early, Nabawa, and Yandilla King respectively.

TIME OF SEEDING.

This is one of the most important factors for the successful production of the wheat crop. The seeding season is a comparatively short one, and as it is known that some varieties are more suitable for early planting, others for midseason and others for late planting, the seeding operations should be so arranged that the varieties selected are planted as near as possible to their optimum, *i.e.*, best seeding period.

Sixty-eight per cent. of the crops was planted during the month of May, and 25 per cent. during April.

The late sown crops were located chiefly in the heavier rainfall districts where the seeding period is later.

Of the 110 crops in the competition, 13 were late maturing wheats, 63 midseason, and 34 early. It has been demonstrated by experiments at the experiment farms that when it is necessary, owing to the area sown, to extend the seeding period outside the month of May, it is better to plant suitable varieties in April rather than to extend the planting period into June.

RATES OF SEEDING.

The rates of seeding varied from 30 lbs. to 64 lbs. per acre. The average rate was 47 lbs. per acre. The majority of the competitors planted from 45-60 lbs. per acre.

Experimental results indicated that for the midseason and early districts, while the yield is not decreased by heavier rates of seeding, no advantage is gained by increasing the amount over 45 lbs.. per acre. In the very early districts, however, the lighter rates of seeding are more suitable. For the late, *i.e.*, heavy rainfall districts, heavier rates can be practised with no disadvantage, particularly when trouble from weed growth is anticipated.

RATES OF SUPERPHOSPHATE.

Superphosphate was applied by every competitor, the average rate of application being 85.2 lbs., a decrease of 12 lbs. upon the previous year's average. The lightest and heaviest applications were 45 lbs. and 150 lbs. respectively, while the majority of the competitors used rates ranging between 80 lbs. and 100 lbs. per acre. The rate of superphosphate has been gradually increasing in most districts. This has been partly due, no doubt, to the fact that the leading competitors have taken advantage of the results of the experiments at the various experiment farms and have obtained profitable results by applying the heavier dressings of superphosphate.

YIELDS.

Since 1925 the Royal Agricultural Society has awarded a special prize of £5 5s. to the competitor who obtains the highest calculated bushel yield per acre from the competing area of 50 acres. The award this year has been made to Mr. H. O. Beeck, of Gnowangerup, whose competing area of the variety "Yandilla

King," yielded 42 bushels per acre. This yield is four bushels less than the State record established in 1929 by Mr. C. E. Cockram, of Pallinup, with the variety "Yandilla King," which yielded 46 bushels per acre. The winners of this prize to date are as follow:—

1925—Hebiton & Sons, Three Springs	Nabawa	34 bush. per acre.
1926—Cuming, Bros., Carnamah ...	Yandilla King ...	38 ,, ,,
1927—A. W. Parkinson, Gnowangerup	Yandilla King ...	40 ,, ,,
1928—A. W. Parkinson, Gnowangerup	Yandilla King ...	40 ,, ,,
1929—C. E. Cockram, Pallinup ...	Yandilla King ...	46 ,, ,,
1930—C. Smith & Sons, Yarding ...	Gluclub	43 ,, ,,
1931—H. O. Beeck, Gnowangerup ...	Yandilla King ...	42 ,, ,,

This year 71 crops were calculated to yield 25 bushels or over per acre. Forty competitors obtained yields of 30 bushels and over, and 17 yields of 35 bushels and over. Those competitors obtaining 30 bushels or over per acre are tabulated below:—

Zone.	Competitor.	District.	Society.	Variety.	Calculated Yield per Acre.
8	Beeck, H. O. ...	Gnowangerup	Gnowangerup...	Yandilla King	42
8	Cochram, C. E. ...	Pallinup ...	Gnowangerup...	Yandilla King	40
1	Hebiton, J. K., senr.	Three Springs	Three Springs...	Merredin ...	40
8	Murray, W. G. ...	Borden ...	Royal	Yandilla King	39
8	Formby, R. & Co., Ltd.	Gnowangerup	Gnowangerup...	Yandilla King	38
8	Tymms, H. O. ...	Gnowangerup	Gnowangerup...	Yandilla King	38
8	Ball, J. L. ...	Gnowangerup	Gnowangerup...	Bena	37
1	Forrester, J. K. ...	Carnamah ...	Royal	Nabawa ...	37
8	Lohoar, J. P. & Sons	South Quairading	Royal	Gluclub ...	36
8	McDonald, J. ...	Gnowangerup	Gnowangerup...	Yandilla King	36
1	Bothe, B. D. ...	Coorow ...	Royal	Bena	35
5	Cook, W. T. ...	South Walgoolan	Merredin ...	Merredin ...	35
1	Cumming, A. S. ...	Carnamah ...	Royal	Merredin ...	35
8	Schneider Bros. ...	Gnowangerup	Gnowangerup...	Nabawa ...	35
8	Stewart, W. B. ...	Gnowangerup	Gnowangerup...	Yandilla King	35
8	Wollard & Wollard	Gnowangerup	Royal	Nabawa ...	35
3	Woodfield	Goomalling...	Royal	Gluclub ...	35
1	Durack, P. M ...	Arrino ...	Three Springs	Merredin ...	34
9	O'Brien, J. ...	Kumarl ...	Southern Mallee	Nabawa ...	34
8	Richards, A. ...	S. Caroling...	Royal	Nabawa ...	34
8	White, R. H. ...	Pallinup ...	Gnowangerup...	Yandilla King	34
1	Green, J. W. ...	Carnamah ...	Royal	Merredin ...	33
8	Murray, A. ...	Tinkurrin ...	Wickepin ...	Canberra ...	33
8	Taylor, H. E. & Sons	Quairading	Wickepin ...	Gluclub ...	33
1	Hilfers & Robertson	Watheroo ...	Royal	Waratah ...	32
5	Lambert, J. B. ...	Koonadgin ...	Merredin ...	Gluclub ...	32
1	Rudduck, A. ...	Coorow ...	Royal	Nabawa ...	32
5	Smith, C. & Sons...	Yarding ...	Bruce Rock ...	Gluclub ...	32
1	Thomas, C. E. ...	Three Springs	Three Springs	Federation ...	32
5	Allen Bros. ...	Central Kumminin	Bruce Rock ...	Gluclub ...	31
7	Freebairn, F. S. ...	Jilakin ...	Kulin	Gluclub ...	31
8	Garnett, J. ...	Gnowangerup	Gnowangerup...	Yandilla King	31
8	Hoskin Bros. ...	Dorakin ...	Wickepin ...	Gallipoli ...	31
4	Landsell, G. ...	Mukinbudin	Nungarin ...	Gluyas Early...	31
5	Smallacombe, ..	Nangeenan ...	Merredin ...	Carrabin ...	31
4	Creagh Bros. ...	Kwelkan ...	Nungarin ...	Gluyas Early...	30
3	Jones, W. W. ...	Cowcowing ...	Royal	Nabawa ...	30
1	McKenzie, N. ...	Three Springs	Three Springs...	Merredin ...	30
2	Moore, T.	Indarra ...	Royal	Merredin ...	30
5	Prowse Bros. ...	Doodlakine...	Doodlakine-Baandee	Gluyas Early...	30

The average calculated yield for all crops inspected was 27.4 bushels per acre, equalling the average for the previous year. This yield has been exceeded on two previous occasions, 1923 and 1924, when the averages were 29 and 31 bushels per acre respectively.

The following table shows the comparison between the yields for the 1930-31 season, and the previous four years:—

Zone.	No. of Competitors 1931.	Average Calculated Yields.				
		1931.	1930.	1929.	1928.	1927.
1 ...	11	33·5	28·2	24·7	29·0	28·0
2 ...	2	26·0	27·6	22·5	19·3	22·4
3 ...	2	32·5	27·5	23·4	21·3	25·6
4 ...	12	25·2	26·1	18·2	18·3	29·2
5 ...	14	28·0	32·7	21·9	20·4	26·2
7 ...	17	21·8	28·6	22·0	23·0	25·6
8 ...	29	31·9	30·0	32·2	31·0	32·0
9 ...	23	23·3	19·8	14·5	...	...
	110	27·4	27·4	20·7*	22·5	26·9

* The results for 1929 included a number of local competitions planted on fallowed land. There were 156 competitors in the Royal and District Competitions that year the average being 21·7 bus. per acre.

It is to be hoped that the efforts of those who carefully prepared their land, and who harvested good returns therefrom, will stimulate others to do likewise. It must be remembered, however, that the test of efficient farming comes when our season is least favourable. It is then that sound methods prove their value.

FALLOWING.

The conditions of the competition required the crops to be sown on fallowed land. In the preparation of the fallows most of the competitors ploughed their land during the winter months of June to August. It has been definitely demonstrated that higher yields are obtained if the land is ploughed early in the fallowing season than when ploughed later. In this connection in an experiment conducted at the Merredin Experiment Farm for six years (1924-1929), the average yield of plots ploughed the first week in June was 3 bushels 51 lbs. more than those ploughed the last week in August.

The average depth of the initial ploughing was from three to four inches, mouldboard and disc ploughs being used for this operation, while in a few cases rigidtyne scarifiers and springtyne cultivators were utilised for the initial cultural operation. The advantages of using a particular type of implement is determined by the type and condition of the soil to be dealt with. Whether the disc or mouldboard is selected, it is essential that the work be done thoroughly.

For the subsequent working of the fallow in preparation of a seedbed, the springtyne cultivator was the implement chiefly used. A disc implement was favoured, however, when the ground was hard or weedy. The rigidtyne cultivator is also designed and is suitable for this purpose.

Sheep are becoming more numerous throughout the Wheat Belt each year, and their value in assisting to control weed growth on fallows is more widely appreciated.

Experiments at the various experiment farms have shown that increased yields were obtained when heavier dressings of superphosphate up to 150 lbs. were used, particularly on the lighter classes of soil.

The drastic change in the economic conditions of wheat farming, however, alters the interpretation of the results of these experiments because, where in the past more liberal dressings of superphosphate were profitable, this is not so to-day.

An analysis of the results of the rate of superphosphate with wheat experiments shows that when superphosphate is valued at £5 a ton and wheat at 2s. a bushel, the limit of profitable application for the heavy forest country appears to be reached with an application of 112 lbs. per acre, and on the light land 120 lbs. per acre.

DISEASES.

Diseases found in the competition crops were Ball, Flag and Loose Smuts, Take-all and similar diseases (Foot Rot and Root Rot) and Septoria and Rust. Frost and wind injury were also observed.

Ball Smut.—Although not greatly in evidence, it is surprising to find this disease in competition crops. Though the number of infected crops is yearly diminishing the economic loss to farmers from this and other preventable diseases is all too large. This disease can be prevented by the use of such fungicides as dry copper carbonate powder or the blustone or formalin solutions. All are reliable fungicides, but of these by far the most popular is the dry copper carbonate dust. When correctly applied, at the rate of 1½ to 2 ounces per bushel, this method is very effective in preventing the disease. An added advantage with this method is that the seed wheat can be treated and stored immediately after harvest without any detrimental effect, and in addition the copper carbonate acts as a preventative against vermin. The presence of Ball Smut in a crop nowadays is not only indicative of faulty treatment, but also of "slipshod" methods. The results with this treatment have been so highly satisfactory that, where care is exercised and the seed thoroughly dusted, the disease can be entirely eliminated.

Flag Smut.—This disease is becoming more in evidence each year. This is probably due to the fact that a considerable number of farmers fail to recognise the disease when present in their crops. Consequently serious damage is caused before control steps are taken.

A wheat plant affected by Flag Smut has the leaves and leaf sheaths curled, twisted and distorted. Together with the stems, they develop long black streaks running paralel with the veins. The streaks are due to ruptures or slits caused by the fungus, and from these comes the black powder or smut from whicch the disease derives its name. The affected parts may become quite blackened, and the smut may even penetrate the hollow centres of the straw. Affected plants are either killed or stunted, and at close view show out quite distinctly among the taller healthy plants. Whole stools may be smutted or only some of the shoots, the remainder forming normal, but undersized, ears with little or no grain.

Unlike Ball Smut, where the chief source of infection is from spores on the seed, this disease is a soil infection. Spores from various agencies find their way into the soil, and remain there to attack the wheat crops. It can be seen, therefore, that its control lies not so much from seed treatment, but more along the lines of crop rotation. As a precaution all seed should be treated with dry copper carbonate, and while there is evidence that this diminishes re-infection to a limited extent, it will not control it. The most effective means of control of this disease are by by cultural methods in conjunction with the growing of resistant wheats, and it is indeed fortunate that such a popular variety as Nabawa is Flag Smut resistant, as are also the late maturing varieties Yandilla King and Sutton. Other resistant wheats are Bencubbin, Carrabin, Geeralying, and Totadgin, all of which are recommended for planting on infected areas. Gluyas Early, Merredin, and Canberra, all early varieties, are very susceptible to this disease.

A certain means of spreading infection throughout the farm is by feeding infected wheaten hay to stock. Oaten hay should be used, as in addition, the growing of oats also assists in the control of the disease Take-all. Badly infested wheat stubbles may be burnt and so prevent stock spreading the spores over the farm, either through the agencies of the manure or by carrying it on their bodies. Early fallow and judicious cultviation to keep down weeds and self sown wheat plants are essential. Where it is known that a paddock is infected, it is advisable to delay seeding until after the first seeding rains.

Briefly, the methods of control are as follow:—

1. Fallow early and well.
2. Keep fallows free of weeds and self-sown wheat.
3. Plant resistant varieties.
4. Plant as late as is safe to plant in the sowing season.
5. Discontinue feeding infected hay to stock.
6. Include oats in the crop rotation.
7. Burn the stubble of badly infected crops.

Loose Smut.—Loose Smut or Flying Smut is more difficult to control, as there is no practical method of seed treatment. Seed from badly infected crops should be discarded, and fresh seed obtained from clean crops.

Take-all was very much in evidence this year. This disease is also the result of soil infection, and its control is very similar to that for Flag Smut. There is, however, no variety, as yet, known to be resistant to this disease, and its control depends, therefore, on the farming practice adopted. In this respect the value of a crop of oats (free of barley or wheat) is of utmost importance.

It was not surprising to find that in some cases where competing crops were badly infested with Take-all, the reason was because no control methods had been taken. *Farmers are advised not to wait until their cropping areas become badly infected before taking steps to control these diseases, but to adopt preventative methods which include the growing of oats in their cropping rotation.*

Rust.—This is a disease, the prevalence of which depends mainly on the seasonal conditions, over which there is no control. In districts where rust is likely to occur, farmers should avoid growing rust-liable wheats.

Septoria.—The disease Septoria is most liable to occur when the wheat crop is planted too early. Under these conditions there is a tendency for the plants to make flaggy and rank growth, and as a result they become more susceptible to infection by the fungus. The control consists of seasonable planting and the practice of clean farming methods.

It is not possible, in the space of this article, to discuss the various diseases fully, but should any reader desire further information concerning these diseases, bulletins are available for free distribution, and can be obtained on application. The bulletins mentioned are:—

Septoria—No. 121.
Rust of Cereals—No. 126.
Flag Smut—No. 134.
Cereal Smuts—No. 160.
Foot Rot and Root-Rot of Wheat—No. 228.
Partial Rot and Root-Rot of Wheat—No. 228.
Partial or complete emptiness in wheat heads—No. 301.
Earcockle and Bacterial Diseases of Wheat—No. 196.

The 50-acre Crop Competitions have proved invaluable for demonstrating the correctness of methods under varying conditions of soil and climate. When sound methods of farming are adopted, higher yields are made possible and, under correct business management, the cost of production lowered.

FIELD EXPERIMENTS WITH WHEAT, 1931.

YILGARN EXPERIMENT FARM.

J. THOMAS, Superintendent of Wheat Farms; R. W. PRUNSTER, Farm Manager.

The monthly rainfalls, as recorded at the farm during 1931, together with the averages for the past four years, are set out hereunder:—

——	Jan.	Feb	Mar.	Apl	Growing Period. May.	June.	July.	Aug.	Sep.	Oct.	Total.	Nov.	Dec.	Total for year.
1931	3	10	8	97	285	131	106	180	83	19	804	80	8	1,019
Average, 4 yrs.	33	77	45	89	204	145	104	101	46	24	624	96	60	1,024

The beginning of the season was marked by the absence of early autumn rains. Very heavy rains fell during the first fortnight in May, but these were followed by a dry period lasting to the end of the first week in June. As a result of the long, dry spell, a crust was formed on the soil surface, and anxiety was felt concerning the young plants breaking through. However though late, the crops came away fairly well after the June rains. Heavy successive frost in June and July were not conducive to quick growth, but good growth was made when the warmer weather set in towards the end of August. Towards the end of the season the seasonal rains terminated early and abruptly. This adversely affected the yield.

The land on which the experiments were conducted was orignially timbered with salmon gum and gimlet. During June and July, 1930, it was disc ploughed to a depth of three to four inches. This was followed by a springtyne cultivation during August and September, and again after rain in December. During March the land was disc cultivated, and again where required after the heavy rain in May. This was followed by the springtyne cultivator immediately prior to planting.

TIME OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

To meet the requirements of the experiment two varieties of different maturity were used—Nabawa, representing the midseason, and Gluyas Early, the early maturing varieties.

The Nabawa plots were planted in mid-April, May, and June respectively, and the Gluyas Early plots were planted in mid-May, June, and July. Each plot was repeated five times.

All plots germinated well, although the May plantings were a little late in getting away. Late rains in October and early November favoured the June and July sown plots.

TIME OF SEEDING EXPERIMENT.

Variety—Nabawa. Superphosphate—90–100lb. per acre. Seed—30lb. per acre.

Planted.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928–31.	Percentage Yields, 1928–31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
April 15th	*	16 48	18 32	20 16	18 32	18 32	103	18 35	108
May 18th	*	17 12	17 36	19 4	18 0	17 58	100	17 8	100
June 17th	*	12 56	12 48	11 44	12 48	12 34	70	9 24	55

* Section 1 discarded owing to error in drilling.

TIME OF SEEDING EXPERIMENT.

Variety—Gluyas Early. Superphosphate—90-100lb. per acre. Seed—30lb. per acre.

Planted.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1931	Percentage Yields, 1931	Average Yields per acre 1928-31.	Percentage Yields, 1928-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
June 17th	14 24	14 0	12 40	14 16	13 44	13 49	84	11 37	70
May 18th	15 12	17 28	15 36	17 4	17 4	16 29	100	16 41	100
July 15th	6 16	8 16	6 48	7 12	6 32	7 1	43	4 52	29

The results this year, and the average results over the four years the experiment has been conducted, show that it is of advantage to plant the mid-season variety, Nabawa, during April rather than in May. By delaying planting until June, however, unprofitable returns can be expected.

Both this year's returns and those of the four years' average show also that early maturing varieties are more prolific when sown in May, and that the yields decrease considerably and are unprofitable should planting be delayed after this month.

RATE OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most economic rate of seeding with—(a) a midseason free-stooling, and (b) an early and sparse-stooling variety.

For the former the variety Nabawa was used, and for the latter the variety Noongaar.

RATE OF SEEDING EXPERIMENT

Planted on 8th May, 1931. Variety—Nabawa Superphosphate—90-100lb per acre

Rate of Seed per acre.	Computed Yields per acre Sec. 1	Sec. 1	Sec. 3	Sec. 4.	Sec. 5	Average Yields per acre 1931	Percentage Yields, 1931	Average Yields per acre 1928-31.	Percentage Yields, 1928-31.
	bus. lb	bus. lb	bus. lb	bus. lb	bus. lb	bus. lb	%	bus. lb	%
20lb	17 20	19 44	17 52	18 40	17 4	18 8	95	17 31	99
40lb	19 4	20 56	19 12	17 52	17 52	18 59	100	17 41	100
30lb.	19 12	21 12	19 52	17 28	17 44	19 6	101	17 15	98

RATE OF SEEDING EXPERIMENT

Planted on 19th May 1931 Variety—Noongaar Superphosphate—90-100lb per acre

Rate of Seed per acre.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre. 1931	Percentage Yields, 1931	Average Yields per acre 1928-31	Percentage Yields, 1928-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
20lb.	13 20	12 32	14 24	14 32	15 4	13 58	81	14 20	96
40lb.	14 16	18 8	17 36	16 48	19 12	17 12	100	14 58	100
30lb.	15 44	16 32	17 4	17 36	17 52	16 58	99	14 54	100

The average results with the early and sparse-stooling varieties for the four years the experiment has been conducted show but little variation with the different rates of sowing. This year, however, the lower rate of seeding at 20 lbs. per acre is shown at a disadvantage.

With the free-stooling variety the average results of the four years are very similar. The results for this year in this section show the 20 lbs. rate of seeding at a slight disadvantage.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine the most economical rate to apply superphosphate to the wheat crop.

This experiment is divided into three sections, in each of which plots treated with 150 lbs. of superphosphate per acre were regarded as controls. Thus, in Section 1, the rates of 300 and 225 lbs. per acre were compared with the control rate of 150 lbs. per acre, and in Section 2 the rates of no application and 75 lbs. per acre were compared with the control rate of 150 lbs.

During the growing season it was noticed that maturity was hastened in the plots treated with the heavier dressings of superphosphate. The plots to which no superphosphate had been applied were still comparatively green when the others had matured. The no superphosphate plots also suffered considerably from "tipping," neither had the plants stooled as well.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO 2.

Planted on 16th May, 1931. Variety—Gluyas Early. Seed—30lb per acre.

Rate of Application of Superphosphate per acre.	Computed Yield per acre										Average Yields per acre 1931		Percentage Yields, 1931	Average Yields per acre, 1929–31.		Percentage Yields, 1929 31.
	Sec 1		Sec 1.		Sec 3		Sec. 4		Sec 5.							
	bus	lb	bus	lb.	bus.	lb.	bus	lb.	bus	lb	bus.	lb	%	bus.	lb.	%
300lb. . .	14	40	19	44	20	40	20	16	18	24	18	25	105	15	7	98
150lb	15	12	18	56	19	12	18	0	18	8	17	54	100	15	31	100
225lb.	17	44	19	28	19	20	16	24	22	8	19	1	106	15	13	98

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO 1.

Planted on 16th May, 1931. Variety—Gluyas Early. Seed—30lb. per acre.

Rate of Application of Superphosphate per acre	Computed Yields per acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929–31.		Percentage Yields, 1929–31.
	Sec. 1.		Sec 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lb.	bus.	lb	bus.	lb	bus.	lb.	bus.	lb	bus.	lb.	%	bus.	lb.	%
Nil	10	40	11	12	11	36	10	24	7	28	10	16	60	10	17	60
150lb.	16	8	18	24	18	40	16	56	15	28	17	7	100	16	59	100
75lb.	16	16	17	52	17	20	13	52	14	0	15	52	93	14	45	87

The average results show that increased yields are obtained when superphosphate is applied up to 150 lbs. per acre.

Under the present economic conditions the most economical rate of application appears to be between 100 and 112 lbs. per acre.

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during the late summer and early autumn.

For the purpose of the experiment three plots were required, and the various rates and times of application of the superphosphate are shown in the accompanying table of results.

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 17th May, 1931. Variety—Gluyas Early. Seed—30lb. per acre.

Time of Application of Superphosphate.	Computed Yield per acre. Sec. 1.	Sec. 2.	Sec. 3	Sec. 4.	Sec. 5	Average Yields per acre. 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928 31.	Percentage Yields, 1928 31.
	bus. lb.	bus lb.	bus. lb.	bus. lb.	bus. lb.	bus lb	%	bus lb	%
75lbs. in April; 150lbs. at Seeding	21 36	19 28	21 4	20 40	19 4	20 22	108	17 56	109
225lbs in April ...	19 4	17 44	20 8	18 16	18 56	18 50	100	16 28	100
150lbs in April; 75lbs. at Seeding	18 24	18 56	19 12	18 16	18 24	18 39	99	16 51	102

The results for last year, and also the average for the four years, confirm the previous conclusion, viz., the yields can be expected to be greater when the greater proportion of superphosphate is applied at seeding time.

SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the midseason, early, and very early maturing varieties of wheat.
2. To determine the most prolific of each of the above types.

To meet the requirements of the experiment three sections were needed, viz.:—

(a) Section 1, planted in April, representing early planting.
(b) Section 2, planted in May, representing midseason planting.
(c) Section 3, planted in June, representing late planting.

Each section, planted in its respective month, was repeated five times, all plots being eventually harvested for grain.

April Planting.

At the time of planting the soil was in good condition and each variety germinated, stooled, and grew well. They were retarded in July by heavy frosts, but made strong growth during the later months.

The very early maturing variety, Noongaar, came into ear early in August, and was very badly injured by frost. The growth of the early varieties was affected but little by the frosts.

SEASONAL PLANTING EXPERIMENT.

April Planting.

Planted on April 16th, 1931. Superphosphate—90–100lb. per acre. Seed—30lb. per acre.

Variety.	Maturity.	Computed Yields per acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Percentage Yields, 1928–31.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Nabawa ...	Midseason ...	20 16	21 4	22 56	22 0	19 44	21 12	100	100*
Bencubbin ...	Midseason ...	24 32	26 48	29 4	28 0	27 36	27 12	128	130*
Gluyas Early ...	Early .	17 44	20 56	21 12	23 44	21 20	20 59	95	90
Nabawa ...	Midseason ..	20 16	21 52	21 4	24 24	22 48	22 5	100	100
Noongaar ...	Very Early	5 4	5 52	6 48	7 36	9 20	6 56	31	62

* 1930–31.

These results show that it is inadvisable to plant a very early variety during April when required for grain.

Very outstanding results were obtained from the new midseason variety, Bencubbin, for the two years it has been included in the trials.

May Planting.

At the time of planting the land was hard in some patches and boggy in others. Owing to the dry spell from mid May to 8th June, the germination was not quite so good as that in the April plots. Shortly after germination growth was retarded by very cold weather, but warmer conditions in August encouraged strong growth.

Late rains during November favoured the midseason varieties.

SEASONAL PLANTING EXPERIMENT.

May Planting.

Planted on 20th May, 1931. Superphosphate—90-100lb. per acre. Seed—30lb. per acre

Variety.	Maturity.	Computed Yields per acre.					Average Yields per acre. 1931.	Percentage Yields, 1931.	Percentage Yields, 1928–31.
		Sec. 1	Sec. 2.	Sec. 3.	Sec. 4	Sec. 5.			
		bus lb.	bus lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Nabawa ...	Midseason .	17 4	17 36	15 4	15 12	14 48	15 57	100	100
Bencubbin	Midseason ...	19 28	21 20	19 44	22 24	17 4	20 0	125	115*
Carrabin .	Early ..	16 56	18 32	16 8	18 16	14 40	16 54	99	98
Nabawa ..	Midseason .	17 28	18 0	17 4	18 24	14 24	17 4	100	100
S.H.J.	Early ...	18 8	16 8	16 0	16 48	15 4	16 26	96	90
Gluyas Early .	Early .	20 56	17 4	20 0	18 24	17 4	18 42	112	108
Nabawa ...	Midseason ...	19 44	16 8	17 4	16 32	14 8	16 43	100	100
Merredin ..	Early ...	21 44	17 52	19 12	17 20	16 16	18 29	111	95
Geeralying ..	Very Early	22 8	15 44	17 44	22 0	21 44	19 52	113	104
Nabawa ...	Midseason ...	20 16	17 4	17 20	17 4	16 24	17 38	100	100
Noongaar ...	Very Early	18 56	16 8	19 4	20 16	18 40	18 37	105	111

*1930–31.

In this section, also, the variety Bencubbin shows to the greatest advantage.

The early varieties also show to advantage compared with the control midseason variety, and the results indicate, in view of the unusual rains which fell in November and which favoured the midseason varieties, that they are the most suitable for May planting in the Yilgarn district.

June Planting.

Germination was good, and all varieties benefited by the late November rains. As a result of this, better growth was noted in this section than has been the case in previous years.

SEASONAL PLANTING EXPERIMENT.

June Planting.

Planted on 17th June, 1931. Superphosphate—90-100lb. per acre. Seed—30lb. per acre.

Variety.	Maturity.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Percentage Yields, 1928-31
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Nabawa ...	Midseason ...	14 40	13 4	13 36	12 40	9 44	12 45	100	100
Bencubbin ...	Midseason ...	17 28	14 56	15 28	13 28	12 24	14 45	116	122*
Carrabin ...	Early ...	15 12	13 44	13 28	12 0	10 56	13 4	99	107*
Nabawa ...	Midseason ...	15 12	11 16	13 36	11 52	11 4	13 12	100	100
S.H.J. ...	Early ...	12 32	12 16	11 4	9 52	9 4	10 58	83	89
Gluyas Early ...	Early ...	16 8	16 56	13 52	13 44	10 56	14 19	112	115
Nabawa ...	Midseason ..	13 52	14 40	12 24	12 32	10 32	12 48	100	100
Merredin ...	Early .	14 0	14 24	12 48	13 4	9 36	12 46	100	99
Geeralying ...	Very Early	14 48	13 52	11 52	12 8	11 20	12 48	96	103
Nabawa ..	Midseason .	15 44	15 4	12 8	12 8	11 52	13 23	100	100
Noongaar ...	Very Early	19 4	17 20	15 44	14 56	12 24	15 51	119	130

* 1930-31.

Both this and previous years' results demonstrate the suitability of Noongaar when late planting is found necessary.

NITROGEN EXPERIMENT.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively, while a third plot, which received no sulphate of ammonia, was used as a control plot. Superphosphate was applied at the rate of 112 lbs. per acre to all plots, which were repeated five times. The experiment was conducted on both fallowed and unfallowed land.

The fallowed section was ploughed with a disc implement during June, 1930, springtyne cultivated in August-September of that year, and again in December after a heavy thunderstorm. It was disc cultivated during March, and again before seeding.

It was then again springtyne cultivated prior to planting.

The unfallowed section was ploughed with a disc cultivating plough immediately prior to seeding. The land was a little wet when ploughed, but a springtyne cultivation brought it into good seeding condition.

The results obtained are tabulated hereunder:—

NITROGEN EXPERIMENT.

Fallow Section.

Planted on 18th and 19th May, 1931. Superphosphate—90 100lb. per acre. Seed—30lb. per acre. Variety—Gluyas Early.

Rate of Application of Superphosphate of Ammonia per acre.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre 1931.	Percentage Yields, 1931.	Percentage Yields, 1929-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
1 cwt.	15 36	13 52	14 24	17 36	20 48	16 27	108	106
Nil	13 20	14 24	13 28	17 30	17 20	15 13	100	100
2 cwt.	14 16	13 12	16 24	20 16	19 44	16 46	110	106

NITROGEN EXPERIMENT.

Non-Fallow Section.

Planted on 18th and 19th May, 1931. Superphosphate—90-100lb. per acre. Variety—Gluyas Early.
Seed—30lb. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930-31.	Percentage Yields, 1930-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
1 cwt.	6 8	8 40	8 32	9 36	8 0	8 11	97	10 26	97
Nil	7 44	8 32	8 32	8 8	9 4	8 24	100	10 43	100
2 cwt.	8 56	8 48	10 48	9 12	9 28	9 26	112	10 38	99

The results obtained from the fallowed section confirm those of previous years, viz., the yields are increased by the application of sulphate of ammonia, but not in sufficiency to be economical.

This year the results of the unfallowed section show that increased yields were obtained when 224 lbs. per acre of sulphate of ammonia were applied. The average results for the two years, however, indicate that no benefit is derived from the application of the nitrogenous fertiliser. This is probably due to the fact that with unfallowed land other factors, such as that of moisture, limit the growth of the wheat crop.

MANGANESE EXPERIMENT.

This experiment was conducted to determine whether any increase in yield would result when a manganese fertiliser was applied to the wheat crop.

Manganese sulphate was applied at planting time to separate plots at two rates, viz., 26 lbs. and 52 lbs. per acre. The addition of 90-100 lbs. per acre of superphosphate ensured the crop receiving its requirements of phosphatic fertiliser.

The two plots were compared with the control plot, which received 90-100 lbs. per acre of superphosphate only.

Each plot was one-eighth of an acre in area, and was repeated so that the experiment was comprised of five sections, each of three plots.

MANGANESE EXPERIMENT.

Planted on 22nd May, 1931. Superphosphate—90-100lb. per acre. Variety.—Noongaar.
Seed—30lb. per acre.

Quantity of Manganese Sulphate per acre.	Computed Yields per acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb	bus. lb	bus lb.	bus. lb.	bus. lb.	bus. lb.	%
26lb.	*	17 52	18 16	19 44	18 16	18 32	108
Nil	15 52	18 24	16 40	18 0	17 4	17 12	100
52lb.	18 32	17 52	17 52	17 12	18 0	17 54	104

* Discarded owing to accident when harvesting.

These results indicate that no substantial increase in yield resulted from the application of a manganese fertiliser under the conditions of the experiment at Yilgarn.

FIELD EXPERIMENTS WITH WHEAT, 1931.

DAMPAWAH EXPERIMENT FARM, PERENJORI.

I. THOMAS, Superintendent of Wheat Farms.
F. GISHUBL, Farm Manager.

The farm is situated 30 miles East of Perenjori, being formerly a portion of Karara Station on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered with York gum, giant mallee, karara and mulga scrub.

This is the first crop grown on this land, which was cleared during 1929 and the early part of 1930. After the burn, as would be expected, a large quantity of ashes remained on the whole area.

During the winter months (July to August) of 1930 the land was ploughed 3-4 inches deep with a disc cultivating plough.

Owing to the subsequent dryness of the season, no further working of the fallow followed until just at seeding time. Planting was done by means of a combined cultivator drill.

The following table shows the rainfall registered at the farm since it was established:—

—	Jan.	Feb.	Mar	Apl	Growing Period							Nov.	Dec	Total for year.
					May	June.	July	Aug	Sept	Oct.	Total			
1928	*	*	*	*	164	94	238	142	71	34	743	6	156	†
1929	17	220	64	..	267	234	60	62	18	33	674	120		1,095
1930	..	.	93	123	48	404	160	93	22	41	768	31	54	1,069
1931	...	12	3	25	237	113	232	95	131	10	848	179	120	1,187

* No records. † Incomplete.

Only 40 points were registered up to May, and this absence of early rains as not conducive to the preparation of a good seed bed. Heavy rains fell during the early part of May, but these were followed by a dry spell lasting well into the month of June. This caused considerable anxiety for the germinating crops. However, good rains from the end of June to early October followed the dry spell.

Severe frosts were recorded from as early as May to as late as October. The earlier frosts had the effect of retarding crop growth, but better progress was made with the advent of warmer weather in early August. Towards the end of August, however, strong hot winds affected the crops, blackening the flag and causing considerable concern for the crops just coming into ear.

The crops planted in May appeared to be the most affected. The rain which fell during September and early October appeared to revive these crops, but the affected patches were subsequently found to have produced but little grain.

Time of Seeding Experiment.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

For the purpose of the experiment two varieties were used, Nabawa, a mid-season, and Gluyas Early, an early maturing variety.

The Nabawa plots were planted mid-April, May, and June, and the Gluyas Early plots mid-May, June, and July.

The results are tabulated below:—

TIME OF SEEDING EXPERIMENT.

Variety—Nabawa. Superphosphate—90lb. per acre Seed—45lb. per acre.

Planted	Computed Yields per Acre										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1930-31.		Percentage Yields, 1930-31.
	Sec. 1		Sec. 2		Sec. 3		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
April	8	48	7	44	7	20	7	28	9	12	8	6	88	7	0	112
May	9	28	8	56	9	4	9	4	9	44	9	15	100	6	16	100
June	4	0	4	40	4	16	4	48	4	16	4	24	48	2	12	35

TIME OF SEEDING EXPERIMENT.

Variety—Gluyas Early Superphosphate—90lbs. per acre. Seed—45lbs. per acre.

Planted.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1930-31.		Percentage Yields, 1930-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
June	11	12	11	12	12	48	12	24	12	48	12	5	135	7	56	86
May	9	4	8	48	9	4	8	56	9	4	8	59	100	9	17	100
July .. .	2	24	2	40	3	12	3	20	2	24	2	48	31	2	43	29

These results are not in agreement with those of the previous year. This year the Nabawa has given higher returns when sown in May rather than in April, whilst the Gluyas Early has yielded better when planted in June rather than in May.

The seasonal conditions already described were responsible for diminished yields, particularly in the May sown plots. Also late rains were more beneficial to the June sown plots rather than to those planted earlier.

In view of this and also of the lack of confirmation with the previous year's results, we cannot draw any conclusions from the results of this experiment to date.

Experience and experiments at other experiment farms, however, have shown that it is not advisable to extend the planting beyond the month of May. Rather than continue the planting period into June, it is better to plant suitable maturing varieties during April.

Rate of Seeding Experiment.

The object of this experiment is to ascertain the most economical rate at which to plant the wheat crop with:—

(a) A midseason, free-stooling variety;

(b) An early, sparse-stooling variety.

To meet the requirements of the former, the standard variety Nabawa was used, and for the latter, the variety Noongaar.

RATE OF SEEDING EXPERIMENT.

Planted on 20th April, 1931. Superphosphate—90lb. per acre. Variety—Nabawa.

Rate of Seed per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929–31.		Percentage Yields, 1929–31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus	lbs	bus.	lbs.	%	bus.	lbs	%
30lbs.	10	0	10	24	10	32	10	24	11	20	10	32	112	10	36	109
45lbs.	8	32	8	32	9	44	10	0	10	24	9	27	100	9	47	100
60lbs.	8	24	8	24	8	48	9	12	9	52	8	56	95	9	7	93

RATE OF SEEDING EXPERIMENT.

Planted on 19th May, 1931. Superphosphate—90lb. per acre. Variety—Noongaar.

Rate of Seed per Acre.	Computed Yields per Acre										Average Yields per acre, 1931		Percentage Yields, 1931	Average Yields per acre, 1929–31		Percentage Yields, 1929–31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs	bus.	lbs.	%	bus.	lbs.	%
30lbs.	7	52	7	52	8	56	8	32	8	48	8	24	104	11	14	103
45lbs.	7	44	8	8	8	16	8	24	7	44	8	3	100	10	54	100
60lbs	7	12	7	52	8	8	8	16	7	12	7	44	96	10	25	96

The results with both the midseason variety Nabawa, and the early variety Noongaar, confirm previous years' results, and indicate that no advantage is obtained when the heavier rates of planting are used.

Rate of Application of Superphosphate Experiment.

This experiment is divided into two sections in order to test the effects of applying the following amounts of superphosphate per acre with the wheat crop:—

Section 1:

No super.

150 lb. per acre (Control).

75 lb. per acre.

Section 2:

225 lb. per acre.

150 lb. per acre (Control).

300 lb. per acre

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 7th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre.

Rate of Application of Superphosphate.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre.		Percentage Yields.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
No Super.	6	24	6	8	7	4	6	56	6	8	6	32	62	6	46	43
150lb.	10	24	10	56	11	36	10	24	9	20	10	32	100	15	40	100
75lbs.	11	44	11	12	11	4	10	48	9	28	10	51	103	14	35	93

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 7th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre

Rate of Application. of Superphosphates.	Computed Yields per Acre.										Average Yields per acre. 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929–31.		Percentage Yields, 1929–31.
	Sec 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
225lbs.	9	4	10	56	9	52	8	0	8	24	9	15	95	15	0	98
150lbs.	9	44	10	48	9	28	9	12	9	20	9	42	100	15	20	100
300lbs.	9	52	9	36	8	16	8	16	9	44	9	9	94	15	17	100

These results confirm those of previous years and also those obtained at the other experiment farms in indicating that no advantage is derived from applying superphosphate at rates above 150 lb. per acre.

This year's results do not indicate an advantage from applications greater than 75 lb. per acre, but this not consistent with the average results from this and other experiment farms.

Nitrogen Experiment, 1931.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of nitrogenous fertiliser are applied to the wheat crop, in addition to an application of superphosphate.

For the purpose of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 120 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. The fertilisers were applied at seeding time. The plots were repeated five times, the whole experiment being sown on fallowed and unfallowed land.

The results obtained are shown hereunder:—

NITROGEN EXPERIMENT.

FALLOW SECTION.

Planted on 8th May, 1931. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—120lbs per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3		Sec. 4.		Sec. 5		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1930-31.		Percentage Yields, 1930–31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
112lbs.	8	48	10	0	7	36	8	48	9	12	8	53	84	8	5	87
Nil	10	48	11	20	10	0	10	40	9	52	10	32	100	9	15	100
224lbs.	8	48	8	56	8	0	8	16	9	36	8	43	83	7	18	79

NITROGEN EXPERIMENT.

NON-FALLOW SECTION.

Planted on 8th May. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—120lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre	Computed Yields per Acre. Sec. 1		Sec. 2		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931		Percentage Yields, 1931.	Average Yields per acre, 1930-31.		Percentage Yields, 1930-31.
	bus	lbs	bus	lbs.	bus.	lbs	bus.	lbs.	bus	lbs	bus	lbs.	%	bus	lbs.	%
112lbs.	6	32	7	12	6	32	6	24	5	36	6	27	82	6	18	83
Nil	7	36	8	24	8	16	7	36	7	20	7	50	100	7	34	100
224lbs . .	6	0	5	44	5	52	5	20	5	44	5	44	73	5	26	72

These results, which are for three years in the case of the fallow section, and for two years in the non-fallow section, indicate that no advantage is obtained by the application of a nitrogenous fertiliser to either fallowed or unfallowed land.

Manganese Experiment.

The object of this experiment is to determine whether any increase in yield is obtained by adding a manganese fertiliser to the wheat crop at planting time.

Manganese sulphate was applied as follows:—

Plot No. 1.—28 lb. manganese sulphate per acre and 112 lb. superphosphate per acre.

Plot No. 2.—112 lb. superphosphate per acre (Control).

Plot No. 3.—56 lb. manganese sulphate per acre and 112 lb. superphosphate per acre.

The results obtained are as follow:—

MANGANESE EXPERIMENT.

Planted on 18th May, 1931. Variety—Gluyas Early. Seed—45lb per acre. Superphosphate—112lb. per acre.

Quantity of Manganese Sulphate per Acre.	Computed Yields per Acre. Section 1.		Section 2.		Section 3.		Section 4.		Section 5.		Average Yields per Acre, 1931.		Percentage Yields, 1931.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28lb.	10	24	11	12	11	36	11	20	12	0	11	18	100
Nil (Control)	11	4	11	4	11	52	10	48	11	52	11	20	100
56lb.	11	12	11	28	11	52	12	0	13	12	11	57	105

These results are similar to those obtained at the other experiment farms and indicate that no substantial increase in yield was obtained by the application of a manganese fertiliser to the wheat crop.

Seasonal Planting Experiment.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the late, midseason, early, and very early maturing varieties of wheat.
2. To determine the most prolific of each of the above types.

To meet the requirements of the experiment, three sections were needed, viz.:—

(a) Section 1, planted in April, representing early planting.
(b) Section 2, planted in May, representing midseason planting.
(c) Section 3, planted in June, representing late planting.

Each section, planted in its respective month, was repeated five times, all plots being eventually harvested for grain.

The standard early variety, Gluyas Early, was planted in the control plots in all sections.

SEASONAL PLANTING EXPERIMENT.

APRIL PLANTING.

Planted on 14th April, 1931. Superphosphate—90lb. per acre. Seed—45lb. per acre.

Variety.	Maturity	Computed Yields per Acre.										Average Yields per Acre, 1931.		Percentage Yields, 1931.
		Section 1		Section 2.		Section 3		Section 4		Section 5				
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
Bencubbin ...	Early ..	9	20	10	24	11	12	10	32	11	20	10	34	95
Gluyas Early	Early .	11	12	10	56	11	28	10	56	11	20	11	10	100
Nabawa ...	Midseason	9	4	8	32	8	24	8	32	8	40	8	38	77
S.H.J. .	Early .	10	32	11	28	10	48	10	32	10	48	10	50	93
Gluyas Early	Early .	12	8	12	40	11	28	11	28	10	24	11	38	100
Carrabin ...	Early ..	11	12	11	52	10	40	11	20	9	44	10	58	94
Merredin ...	Early ..	10	8	10	0	8	16	9	44	9	4	9	26	81
Gluyas Early	Early ...	11	12	11	44	11	28	12	16	11	28	11	38	100
Noongaar ...	Very Early	12	8	12	40	12	8	12	32	12	16	12	21	106

SEASONAL PLANTING EXPERIMENT.

MAY PLANTING.

Planted on 14th May, 1931. Superphosphate—90lb. per acre. Seed—45lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.										Average Yields per Acre, 1931.		Percentage Yields, 1931.
		Section 1.		Section 2		Section 3.		Section 4.		Section 5.				
		bus.	lbs.	bus	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
Geeralying ..	Early ...	7	36	6	0	5	52	5	20	5	12	6	0	53
Gluyas Early	Early ...	12	16	12	24	10	48	10	56	10	24	11	22	100
S.H.J. ...	Early ...	5	12	5	20	6	8	4	48	4	8	5	7	45
Bencubbin ...	Midseason	14	32	12	56	13	44	12	32	12	48	13	18	117
Gluyas Early	Early ...	11	36	11	52	11	52	11	12	10	24	11	23	100
Nabawa ...	Midseason	8	48	8	56	7	28	6	56	7	28	7	55	70
Carrabin ...	Early ...	10	40	10	8	8	16	7	44	7	36	8	53	75
Gluyas Early	Early ...	13	12	12	32	12	8	10	40	10	40	11	50	100
Merredin ...	Early ...	8	32	9	12	9	20	7	20	7	4	8	18	70
Gluyas Early	Early ...	11	36	12	8	12	48	11	20	10	40	11	42	100
Noongaar ...	Very Early	8	48	6	8	6	0	4	48	5	12	6	11	53

SEASONAL PLANTING EXPERIMENT.

JUNE PLANTING.

Planted on 15th June, 1931. Superphosphate—90lb. per acre. Seed—45lb. per acre.

Varieties.	Maturity.	Computed Yields per Acre.										Average Yields per Acre, 1931.		Percentage Yields, 1931.
		Section 1.		Section 2.		Section 3.		Section 4.		Section 5.				
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus	lbs.	bus.	lbs.	%
Geeralying ...	Early ...	10	56	12	32	12	24	11	36	11	36	11	49	101
Gluyas Early	Early ...	11	4	11	28	12	24	11	36	11	44	11	39	100
S.H.J. ...	Early ...	11	20	12	48	11	52	12	0	11	28	11	54	102
Merredin ...	Early ..	10	56	12	16	11	44	10	56	11	28	11	28	99
Gluyas Early	Early .	11	4	11	52	11	12	11	20	12	16	11	33	100
Noongaar ..	Very Early	14	8	14	16	14	8	13	28	14	32	14	6	122

These results indicate the suitability of the early and very early maturing varieties for this district.

The midseason variety, Benubbin, shows to considerable advantage in the May planting, and the very early variety Noongaar in the June planting. Of the early varieties, the standard variety, Gluyas Early, shows to best advantage.

FIELD EXPERIMENTS WITH WHEAT, 1931.

CHAPMAN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms; F. L. SHIER, Farm Manager.

The following table shows the monthly rainfalls, as recorded at the farm, during 1931, together with the averages over the past 26 years.

—	Jan.	Feb.	Mar	Apl	Growing Period							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total			
1931 ..	.	.	12	61	459	241	486	273	200	96	1,755	125	56	2,009
Average, 26 years	17	42	67	63	241	441	367	247	170	99	1,598	32	26	1,841

The rainfall during the autumn months was very light, no rain of any consequence falling until the 3rd of May. From this date up to the 16th almost continuous rains were experienced, 453 points being recorded. In consequence, seeding operations were delayed during that period. However, this was followed by a dry period lasting until the 8th of June, enabling crops to be planted under ideal conditions. Good rains were experienced throughout the growing period, 1,755 points being recorded from 1st May to 31st October.

The land on which the experiments were conducted originally carried jam and wattle timber, with a sprinkling of york gum. It was ploughed with a mouldboard plough to a depth of 4 inches during June and July, 1930, springtyne cultivated during September and October, and again immediately prior to seeding.

TIME OF SEEDING EXPERIMENT.

This experiment was commenced in 1923, and has been planted each year since with the early maturing variety Gluyas Early, but owing to the plots being destroyed by fire in 1924 and other factors interfering with the results in 1925 and 1926, the results were not obtained for these years.

Commencing in 1928, the midseason variety, Nabawa, was included in the experiment.

Each variety was planted as a separate experiment, the Gluyas Early being planted in mid-May, June, and July, and the Nabawa in mid-April, May, and June.

TIME OF SEEDING EXPERIMENT.

Variety—Nabawa. Superphosphate—112lbs. per Acre. Seed—60lbs per Acre.

Planted.	Computed Yields per Acre. Sec. 1		Sec. 2		Sec. 3		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928-31.		Percentage Yields, 1928-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
April 16th ..	9	20	9	4	8	48	8	48	9	4	9	1	69	8	57	77
May 16th ..	14	32	13	4	12	48	12	40	12	32	13	7	100	11	41	100
June 15th ...	12	16	11	28	10	48	10	40	11	52	11	25	87	10	45	92

TIME OF SEEDING EXPERIMENT.

Variety—Gluyas Early. Superphosphate—112lbs per Acre. Seed—60lbs per Acre.

Planted.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928-31.		Percentage Yields, 1928-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
June 16th	9	4	8	16	7	12	8	16	8	8	8	11	60	12	41	81
May 19th ...	13	26	12	48	13	36	13	28	14	40	13	38	100	15	38	100
July 15th ..	6	40	6	56	6	24	6	32	7	12	6	45	50	8	5	52

This year's results confirm the average results over a number of years, and indicate the advisability of planting the wheat crop during the month of May.

RATE OF SEEDING EXPERIMENT.

This experiment is carried out with an early sparse-stooling variety, S.H.J., and a midseason free-stooling variety, Nabawa, the object being to ascertain the most economical rate to plant the wheat crop. The experiment has been conducted since 1923, but in 1926 the results of the free-stooling variety were influenced by outside factors, and are therefore not included in the averages.

RATE OF SEEDING EXPERIMENT.

Planted on 14th May, 1931. Variety—Nabawa. Superphosphate—112lbs. per Acre.

Rate of Seed per per acre.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1923-31.		Percentage Yields, 1923-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
60lbs.	17	36	17	20	16	16	17	12	17	4	17	5	105	15	26	100
45lbs.	16	48	16	8	16	8	16	24	16	0	16	17	100	15	25	100
90lbs.	16	56	16	56	17	20	17	44	16	32	17	5	105	16	19	106

RATE OF SEEDING EXPERIMENT.

Planted on 29th May, 1931. Variety—S.H.J. Superphosphate—112lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields, per acre, 1923–31.		Percentage Yields, 1923–31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
60lbs.	15	52	15	20	16	0	15	20	16	0	15	42	118	16	23	107
45lbs.	13	12	12	56	13	44	13	4	13	44	13	20	100	15	23	100
90lbs.	14	56	16	36	16	16	16	56	16	56	16	24	123	16	52	110

The results for both varieties show that it is advantageous to increase the rate of seed to above 45 lbs. per acre, probably the most economical rate being 60 lbs. per acre.

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be economical to apply part or all of this fertiliser when cultivating the fallowed land during the autumn months.

The detailed results for 1931, together with the average results for the four years the experiment has been in progress, are shown hereunder:—

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 13th May, 1931. Variety—Nabawa. Seed—60lbs. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928 31		Percentage Yields, 1928–31
	Sec. 1.		Sec 2		Sec. 3.		Sec. 4		Sec 5.							
	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs	bus	lbs.	bus.	lbs	%	bus	lbs.	%
75lbs. in March, 150lbs. at Seeding	18	48	19	44	19	20	18	24	17	12	18	42	110	14	43	106
225lbs. in March	17	28	18	24	17	36	16	16	15	28	17	2	100	13	48	100
150lbs. in March, 75lbs at Seeding	17	44	18	24	17	20	15	36	13	28	16	30	97	13	54	101

These results do not indicate any advantage derived from applying part of the fertiliser before seeding, the yields being greatest when the larger portion of the superphosphate was applied at planting.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most profitable rate of superphosphate to apply to the wheat crop.

To meet the requirements the experiment was designed so that the three plot system could be maintained. It was therefore divided into two sections, viz.:—

Section 1, consisting of three plots, which received respectively 300 lbs., 150 lbs., and 225 lbs. per acre.

Section 2, consisting of three plots, which received respectively no superphosphate, 150 lbs., and 75 lbs. of superphosphate.

In each section the rate of 150 lbs. per acre was regarded as the control.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 14th May, 1931. Variety—Nabawa. Seed—60lbs. per acre.

Rate of Superphosphate per acre.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929–31.		Percentage Yields, 1929–31.
	bus.	lbs.	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
300lbs.	19	44	21	36	22	0	21	4	18	40	20	37	111	15	30	105
150lbs.	18	40	18	40	19	28	18	56	17	28	18	38	100	14	46	100
225lbs.	19	52	20	56	20	48	18	40	19	28	19	56	107	15	42	106

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 14th May, 1931. Variety—Nabawa. Seed—60lbs. per acre.

Rate of Superphosphate per acre.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields, per acre, 1929–31.		Percentage Yields, 1929–31.
	bus.	lbs.	bus.	lbs.	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
Nil	14	24	13	28	13	52	13	12	13	44	13	44	70	11	37	78
150lbs.	20	0	20	32	18	48	20	48	18	48	19	47	100	14	52	100
75lbs.	17	4	18	0	17	44	17	52	17	12	17	34	89	13	33	91

The plots receiving no superphosphate would benefit from the residual superphosphate applied in previous years. As the experiment will be planted on the same land each year, this residual effect will gradually disappear. However, this year's experiment and the average results over three years indicate that the rate of superphosphate could be increased with advantage above 75 lbs. per acre. Although the applications of higher rates of superphosphate give increased yields, the most economical rate under present economic conditions would probably be about 112 lbs. per acre.

MANGANESE EXPERIMENT.

This experiment was inaugurated to determine whether any advantage was derived from applying a manganese fertiliser to the wheat crop.

Manganese sulphate was applied to separate plots at planting time, as follows:—

Plot 1. 28 lbs. managanese sulphate per acre.

Plot 2. No manganese sulphate (control).

Plot 3. 56 lbs. manganese sulphate per acre.

Superphosphate was applied to all plots at 112 lbs. per acre.

The results obtained are set out hereunder:—

MANGANESE EXPERIMENT.

Planted on 22nd May, 1931. Superphosphate—112lbs. per Acre. Seed—60lbs. per Acre. Variety—Nabawa.

Quantity of Manganese Sulphate per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields. 1931.
	Section 1.		Section 2.		Section 3.		Section 4.		Section 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28lbs.	20	16	20	48	20	32	22	8	22	0	21	9	103
Nil (Control)	19	36	19	36	20	48	20	56	22	8	20	37	100
56lbs.	20	16	20	40	20	56	22	8	21	36	21	7	103

These results are for one year only. However, they confirm the results from the other experiment farms, and indicate that no substantial increase in yield results from the application of a manganese fertiliser to the wheat crop.

NITROGEN EXPERIMENT.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. per acre respectively, the application in each case being at planting time.

Superphosphate was applied to all plots at the rate of 112 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls.

The experiment was conducted on both fallowed and unfallowed land, the results being shown hereunder:—

NITROGEN EXPERIMENT.

FALLOW SECTION.

Planted on 20th May, 1931. Superphosphate—120lbs. per Acre. Seed—60lbs. per Acre. Variety—Nabawa.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs	bus.	lbs.	%	%
112lbs.	15	28	15	44	18	8	16	0	14	48	16	2	81	98
Nil	21	12	19	12	20	56	18	8	19	20	19	46	100	100
224lbs.	15	28	14	56	15	20	15	20	15	28	15	18	77	94

NITROGEN EXPERIMENT.

NON-FALLOW SECTION.

Planted on 20th May, 1931. Superphosphate—120lbs. per acre. Variety—Nabawa.
Seed—60lbs. per Acre.

Rate of Application of Sulphate of Ammonia per Acre	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1929–31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
112lbs.	20	8	20	48	18	48	19	36	19	4	19	41	105	112
Nil	19	28	19	12	18	40	20	0	16	32	18	46	100	100
224lbs.	20	0	20	16	17	52	21	36	19	36	19	52	106	121

These results do not indicate that any increase in yield can be expected by applying a nitrogenous fertiliser to fallowed land in the Chapman district. They do, however, indicate an increase in yield when the nitrogenous fertiliser is applied to unfallowed land. It is doubtful, however, whether the increase would be sufficient to consider the application of a such a fertiliser as an economical proposition.

SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the late, mid-season, early, and very early maturing varieties of wheat; and
2. To determine the most prolific of each of the above types.

To meet the requirements of the experiments, three sections were needed, viz.:—

(a) Section 1, planted in April, representing early planting.
(b) Section 2, planted in May, representing midseason planting.
(c) Section 3, planted in June, representing late planting.

In all sections the standard midseason maturing variety, Nabawa, was planted in the control plots.

The results are given below:—

SEASONAL PLANTING EXPERIMENT.

APRIL PLANTING.

Planted on 15th April, 1931. Superphosphate—112lbs. per Acre. Seed—60lbs. per Acre.

Variety.	Maturity.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928–31.
		Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Yandilla King	Late ...	8	16	8	40	9	4	10	32	8	32	9	1	97	81
Nabawa ...	Midseason...	8	16	9	12	9	52	9	52	9	4	9	15	100	100
Sutton ...	Late ...	8	32	10	16	10	56	10	56	10	0	10	8	110	105*
Bencubbin ...	Midseason...	10	32	12	32	13	4	13	20	11	44	12	15	131	148*
Nabawa ...	Midseason...	8	40	9	20	10	0	9	36	9	4	9	20	100	100
Gluyas Early	Early ...	9	4	10	32	11	52	10	32	9	20	10	16	110	105

* Average two years, 1930–31.

SEASONAL PLANTING EXPERIMENT.

MAY PLANTING.

Planted on 18th May, 1931. Superphosphate—112lb. per acre. Seed—60lb. per acre.

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928-31.
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Yandilla King	Late ...	15	44	14	40	15	28	15	36	14	32	15	12	99	93
Nabawa ...	Midseason...	16	24	16	0	15	4	15	12	14	8	15	22	100	100
Sutton ...	Late ...	17	4	16	16	16	48	17	4	15	36	16	34	108	111*
Bencubbin ...	Midseason ..	18	32	17	52	18	0	18	24	17	12	18	0	116	118*
Nabawa ...	Midseason...	15	44	16	16	14	48	16	0	14	48	15	31	100	100
Comeback ...	Early ...	10	56	12	8	11	12	13	4	12	32	11	58	77	84†
Carrabin ...	Early ...	13	52	13	4	13	52	14	24	14	40	13	58	90	96
Nabawa ..	Midseason...	15	44	14	40	15	20	16	8	15	36	15	30	100	100
S.H.J. ..	Early ...	14	40	15	28	14	32	18	0	17	4	15	57	103	102
Merredin ..	Early ...	13	44	14	56	15	12	16	8	16	48	15	22	99	101
Nabawa ..	Midseason...	14	40	15	44	14	56	15	36	16	32	15	29	100	100
Gluyas Early	Early ...	16	0	15	36	15	12	16	16	16	0	15	49	102	98
Geeralying ...	Early ..	13	4	13	20	14	0	14	8	16	32	14	13	92	96
Nabawa ...	Midseason. .	14	40	15	12	15	44	14	16	17	4	15	23	100	100
Noongaar ...	Very Early	12	0	11	36	9	12	11	44	11	36	11	14	73	78

* Average two years, 1930-31. † Average three years, 1929-31.

SEASONAL PLANTING EXPERIMENT.

JUNE PLANTING.

Planted on 16th June, 1931. Superphosphate—112lb. per acre. Seed—60lb per acre.

Variety.	Maturity.	Computed Yields per Acre Sec. 1		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928-31.
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Bencubbin ...	Midseason ..	12	24	17	44	15	20	10	48	7	12	12	42	112	111*
Nabawa ...	Midseason...	9	52	16	56	12	32	10	16	7	20	11	23	100	100
Comeback ...	Early ...	6	32	13	28	9	28	6	32	4	24	8	5	71	76*
Carrabin ...	Early ...	8	0	14	0	9	52	8	0	6	24	9	15	83	85*
Nabawa .	Midseason...	9	28	17	4	13	4	9	20	7	4	11	12	100	100
S.H.J ...	Early ...	11	12	13	36	10	16	7	36	5	44	9	41	86	91
Merredin ...	Early ...	10	0	15	12	10	40	7	20	5	44	9	49	85	89
Nabawa ...	Midseason...	11	20	17	12	12	56	8	56	7	4	11	30	100	100
Gluyas Early	Early ...	10	56	14	40	11	4	7	12	5	28	9	52	86	91
Geeralying ...	Early ...	10	32	13	36	10	32	6	56	6	0	9	31	83	88
Nabawa ...	Midseason...	13	36	16	8	12	48	7	36	7	4	11	26	100	100
Noongaar ...	Very Early	9	36	10	56	8	40	5	20	5	28	8	0	70	80

* Average two years, 1930-31.

In all sections the midseason variety, Bencubbin, has shown to advantage. The late maturing variety, Sutton, has also yielded comparatively well in both the April and May planted sections.

The experiment shows the suitability of the midseason and late maturing varieties for early planting in this district. For later planting, the varieties, Gluyas Early, Merredin, and S.H.J. have proved to be the most suitable of the early maturing varieties.

These results also show, when weeds are troublesome, the advisability of delaying seeding until after the seasonal rains have commenced, and so enable the young weeds to be destroyed prior to planting.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

AVONDALE STATE FARM.

A. S. WILD, Agricultural Adviser; H. J. BAILEY, Farm Manager.

During 1931 the following experiments were conducted at the Avondale State Farm:—

1. A Manganese Experiment with Wheat.
2. A Variety Trial with Oats.

The following table shows the rainfalls, as recorded at the farm during the year, together with the monthly averages over the past six years:—

-----	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug	Sept	Oct.	Total.			
1931 ...	.	4	43	93	300	172	320	477	325	44	1,638	..	73	1,851
Average, 6 years	13	35	117	90	177	318	450	258	167	74	1,444	54	36	1,789

The season commenced with good rains during the end of April and early May. This caused the weed seeds to germinate and enabled the destruction of the young weeds and the preparation of a good seed bed.

Severe late frosts were recorded, and this had an adverse effect on the yields The oat plots were also affected by high winds when approaching maturity.

Although diminished during October, the rainfall for the growing period (1,638 points) must be considered as satisfactory. The total rainfall for the year was 1,851 points, the average for this period over six years being 1,789 points.

The land on which the experiments were conducted was typical York gum and jam country which had been cleared for many years. It was ploughed four inches deep during June of the previous year. It was then springtyne cultivated during early April, again in late April, and again just prior to seeding.

MANGANESE EXPERIMENT.

The object of this experiment was to determine whether the application of a manganese fertiliser would benefit the wheat crop. Two rates of manganese sulphate were used, the plots being laid out as follows:—

Plot 1.—28 lbs. manganese sulphate + 112 lbs. superphosphate per acre.

Plot 2.—112 lbs. superphosphate per acre (control).

Plot 3.—56 lbs. manganese sulphate per acre + 112 lbs. superphosphate per acre.

Each plot was one-eighth of an acre in area, and each was repeated five times. The results of the experiment are given in the table below:—

MANGANESE EXPERIMENT.

Planted on 14th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb. per acre.

Quantity of Manganese Sulphate per acre.	Computed Yields per acre. Section 1.	Section 2.	Section 3.	Section 4.	Section 5.	Average Yields per acre 1931.	Percentage Yields, 1931.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
28lb.	16 48	17 44	14 16	15 44	12 8	15 20	97
Nil	17 44	15 44	14 48	15 20	15 44	15 52	100
56lb.	17 4	15 20	13 4	15 20	14 24	15 2	95

The above results are similar to those obtained from the same experiment at the other Experiment Farms, and indicate that no increase in yield was obtained by supplementing the superphosphate with a manganese fertiliser.

OAT VARIETY TRIAL.

The object of this experiment is to determine the most suitable variety of oat for grain purposes in districts having similar climatic conditions. The results obtained are as follow:—

OAT VARIETY TRIAL.

Planted on 8th May, 1931 Seed—40lb. per acre. Superphosphate—90lb. per acre.

Variety.	Maturity.	Computed Yields per acre. Section 1.	Section 2.	Section 3.	Section 4.	Section 5	Average Yields per acre 1931.	Percentage Yields, 1931.
		bus. lb	bus lb.	bus lb.	bus. lb.	bus. lb.	bus. lb.	%
Mulga ...	Early ..	20 24	22 24	23 24	22 24	22 8	22 13	75
Guyra ...	Midseason	31 16	23 0	30 16	34 0	29 24	29 27	100
Burts' Early	Early ...	32 16	22 24	24 0	22 24	20 0	24 13	82
Algerian ...	Late ..	29 32	28 24	29 0	23 0	27 0	27 19	107
Guyra ..	Midseason	31 16	29 32	21 8	26 16	19 24	25 27	100
Lachlan ...	Midseason	28 8	28 16	24 24	27 16	26 16	27 0	105

These results indicate the suitability of the midseason and late maturing varieties. They also confirm previous results (see "Agricultural Journal," June, 1930, page 297), viz., that the late variety, Algerian, and the midseason variety, Guyra, are the most suitable for grain.

Time of Application of Superphosphate Experiment.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during late summer or early autumn.

The land was ploughed in June, 1930, to a depth of 4 inches and cultivated in August with a disc cultivating plough. It was harrowed after rain on 7th April, then worked with a tandem disc cultivator and afterwards with a springtyne.

The results, together with those of previous years, are given below:—

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 16th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre.

Time of Application of Superphosphate.	Computed Yields per acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre. 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928-31.		Percentage Yields, 1928-31.
	bus.	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus	lbs.	%
75lb. in March, 150lb. at Seeding	30	24	28	16	30	8	30	16	28	48	29	34	108	25	42	107
225lb. in March ...	27	44	26	40	27	52	26	32	27	52	27	20	100	24	7	100
150lb. in March; 75lb. at Seeding	26	32	28	0	27	12	27	12	28	24	27	28	100	25	30	106

These results indicate that the yield of a wheat crop is decreased when portion of the fertiliser is not applied at seeding time.

Rate of Application of Superphosphate Experiment.

This experiment is divided into two sections, in each of which plots treated with 150 lb. of superphosphate per acre are regarded as controls. Thus in Section 1, the rates of 300 lb. and 225 lb. per acre are compared with the control rate of 150 lb. per acre and in Section 2, the rates of 75 lb. per acre and no superphosphate are compared with the same control rate of 150 lb.

From the yields of the plots where no superphosphate was applied, it is evident that the crop was benefiting from the residual effects of previous dressings. This residue, however, will eventually become exhausted as the "No superphosphate" plot falls in the same position in succeeding years.

The land received similar working to that of the Time of Application of Superphosphate Experiment.

The results obtained are shown hereunder:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 16th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre.

Rate of Application of Superphosphate per acre	Computed Yields per acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929-31.		Percentage Yields, 1929-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
300lb.	29	44	29	28	30	8	30	56	26	40	29	23	101	28	33	105
150lb.	28	40	28	40	29	52	29	20	28	56	29	6	100	27	12	100
225lb.	30	24	28	56	29	36	27	12	30	24	29	18	101	28	7	103

RATE OF APPLICATION OF SUPERPHOSPHATE. EXPERIMENT.

Planted on 16th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre.

Rate of Application of Superphosphate per acre.	Computed Yields per acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929-31.		Percentage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs	bus.	lbs.	%	bus.	lbs.	%
No Superphosphate ..	24	24	21	12	18	48	18	56	14	16	19	31	71	17	30	63
150lbs.	31	20	27	12	25	36	26	8	26	48	27	25	100	27	36	100
75lbs.	27	20	30	24	26	40	22	24	27	36	26	53	98	25	45	93

The average results for three years indicate that the rate of superphosphate applied per acre should be not less than 75 lb. and that the most profitable rate under present economic conditions would be about 112 lb. per acre.

Seasonal Planting Experiment.

The objects of this experiment are: -

1. To ascertain the most suitable month for planting the early, midseason, and late maturing varieties of wheat.
2. To determine the most prolific of the three types.

To meet the requirements of this experiment three sections were needed, viz.:—

(a) Section 1, planted in April, representing early planting.
(b) Section 2, planted in May, representing midseason planting.
(c) Section 3, planted in June, representing late planting.

The arrangement of this experiment was similar to that of last year. Nabawa was planted as the control in each of the three sections.

The land was ploughed in June, 1930, to a depth of 4 inches with disc ploughs and cultivated in August with a disc cultivating plough. After rain in April it was harrowed, then worked with a tandem disc cultivator and afterwards with a springtyne cultivator.

The tabulated results are shown hereunder:—

SEASONAL PLANTING EXPERIMENT.

APRIL PLANTING.

Planted on 17th April, 1931. Superphosphate—112lb. per acre. Seed—42lb. per acre.

Variety.	Maturity.	Computed Yields per acre.										Average Yields, per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928-31.
		Sec. 1.		Sec. 2		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus	lbs.	bus.	lbs.	bus.	lbs.	%	%
Yandilla King ...	Late ...	18	16	15	12	14	16	14	48	15	44	15	39	110	82
Nabawa ...	Midseason ...	18	24	12	24	11	12	15	20	14	8	14	18	100	100
Bencubbin ...	Midseason ...	27	20	13	20	15	52	20	16	17	52	18	56	132	115*
Sutton ...	Late ...	19	12	10	32	14	8	17	12	13	44	14	58	104	...
Nabawa ...	Midseason ...	15	36	11	20	15	12	17	20	12	40	14	26	100	100
Gluyas Early ...	Early ...	11	20	7	4	8	48	9	36	6	40	8	42	60	82
Totadgin ...	Early ...	9	36	8	16	11	12	10	48	7	36	9	30	71	89†
Nabawa ...	Midseason ...	15	20	11	28	14	40	13	52	11	44	13	25	100	100
Carrabin ...	Early ...	10	32	4	0	5	52	4	56	4	48	6	2	45	82

* 1929–31. † 1930–31.

SEASONAL PLANTING EXPERIMENT.

MAY PLANTING.

Planted on 20th May, 1931. Superphosphate—112lb. per acre. Seed—45lb. per acre.

Variety.	Maturity.	Computed Yields per acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928-31.
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Yandilla King ..	Late ...	25	4	23	44	18	8	21	4	18	8	21	14	93	77
Nabawa ...	Midseason ...	26	48	24	40	20	40	20	8	22	8	22	53	100	100
Sutton	Late ...	22	16	22	40	17	12	18	0	20	24	20	6	88	...
Bencubbin ...	Midseason ...	25	36	27	36	22	8	24	16	26	0	25	7	110	114*
Nabawa ..	Midseason ..	22	48	23	12	20	8	19	36	20	32	21	15	100	100
Merredin ..	Early ...	26	48	26	16	23	20	23	20	27	12	25	23	120	110
Gluyas Early ...	Early .	28	56	27	20	23	4	21	28	26	8	25	23	121	110
Nabawa ...	Midseason ...	23	28	19	44	19	52	18	32	23	28	21	1	100	100
Totadgin ...	Early ..	30	40	27	52	24	40	24	0	26	56	26	50	128	...
Carrabin ..	Early ..	26	56	24	56	20	32	18	8	20	48	22	16	95	100
Nabawa ..	Midseason ...	29	12	23	36	20	16	21	20	22	48	23	26	100	100
Geeralying ..	Early ..	31	4	28	8	23	52	23	4	27	44	26	46	114	100
S.H.J.	Early ..	24	40	26	16	20	0	20	16	22	48	22	48	100	95
Nabawa ...	Midseason ..	25	20	25	52	19	4	19	44	24	8	22	50	100	100
Noongaar ...	Very Early ...	27	4	25	20	22	56	20	56	23	36	23	58	105	110

* 1929-31.

SEASONAL PLANTING EXPERIMENT.

JUNE PLANTING.

Planted on 16th June, 1931. Superphosphate—112lb. per acre Seed—45lb per acre.

Variety	Maturity	Computed Yields per acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928-31.
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus	lbs.	%	%
Bencubbin .	Midseason ..	20	0	15	28	20	40	17	23	17	4	18	8	109	117
Nabawa ...	Midseason ...	19	12	13	52	18	32	16	48	15	20	16	45	100	100
Gluyas Early ...	Early ...	20	48	14	8	20	0	17	28	16	56	17	52	107	113*
Totadgin ...	Early ...	20	0	15	20	21	28	18	24	19	36	18	58	137	...
Nabawa ...	Midseason ...	16	16	11	28	15	4	12	48	13	36	13	50	100	100
Merredin ...	Early ..	18	48	16	56	16	32	13	36	16	8	16	24	119	112
S.H.J. ...	Early .	12	32	12	32	11	52	9	44	11	52	11	42	79	90
Nabawa ...	Midseason ..	14	48	15	12	15	28	12	48	15	36	14	46	100	100
Carrabin ...	Early ...	11	36	13	12	13	44	11	4	12	56	12	30	85	97
Geeralying ...	Early ..	15	44	16	56	17	4	14	16	19	4	16	37	103	98
Nabawa ...	Midseason ...	14	0	17	52	15	4	14	16	19	36	16	10	100	100
Noongaar ...	Very Early .	14	56	18	0	16	56	16	56	20	16	17	25	107	115

* 1929-31.

It will be seen that the midseason maturing variety, Bencubbin, has shown to advantage in all sections, particularly when planted during April.

The results of the new early variety, Totadgin, in both the two later planting sections, are most encouraging, and it appears to challenge Gluyas Early as the standard early variety.

Generally the experiment indicates that the early and very early maturing varieties are unsuitable for early planting in this district. However, they do show to considerable advantage when planted in May and June, the higher and therefore the more profitable yields being obtained from planting during the former month.

Of the early varieties, Totadgin, Gluyas Early, Merredin, and Noongaar have given the most satisfactory yields.

Nitrogen Experiment.

The objects of this experiment are:—

1. To determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to an application of superphosphate.
2. To ascertain whether it is advantageous to apply only part of the nitrogenous fertiliser at seeding time and part during the month of August.

This experiment is divided into two sections, one fallowed and the other unfallowed. The fallowed plots were ploughed in June, 1930, to a depth of 4 inches with a disc plough, springtyne cultivated in September, harrowed after rain in April, and again springtyne and disc cultivated before seeding.

The unfallowed plots were ploughed after rain in early April, then springtyne cultivated, and again cultivated with a disc implement before seeding:

Superphosphate was applied to all plots at the rate of 112 lb. per acre, and those plots to which superphosphate only was applied were treated as controls. For the purposes of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively, and all plots were repeated five times.

The results obtained are tabulated below:—

NITROGEN EXPERIMENT.

FALLOW SECTION.

Planted on 29th May, 1931. Superphosphate—112lb. per acre. Seed—45lb. per acre. Variety—Gluyas Early.

Rate of Application of Sulphate of Ammonia per acre	Computed Yields per acre. Section 1		Section 2		Section 3		Section 4		Section 5.		Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1929-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
½ cwt. at Seeding; ½ cwt. in Aug	16	8	22	8	22	0	21	52	23	20	21	6	100	100
Nil	19	4	21	12	21	28	22	24	21	36	21	9	100	100
1 cwt at Seeding	21	44	21	52	21	36	22	24	21	20	21	47	103	102
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
1 cwt. at Seeding; 1 cwt. in Aug.	21	52	20	56	21	4	22	40	22	8	21	44	103	103
Nil	20	24	21	12	20	56	22	56	20	16	21	9	100	100
2 cwt. at Seeding	20	24	21	44	21	44	23	44	20	16	21	34	102	104

NITROGEN EXPERIMENT.

UNFALLOWED SECTION.

Planted on 29th May, 1931. Superphosphate—112lb. per acre. Seed—45lb. per acre. Variety—Gluyas Early.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per acre. Section 1.		Section 2		Section 3.		Section 4.		Section 5.		Average Yields per acre, 1931		Percentage Yields, 1931	Percentage Yields, 1929-31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
½ cwt. at Seeding; ½ cwt. in Aug.	14	40	16	16	16	40	15	28	18	56	16	24	101	101
Nil	14	16	15	12	14	56	16	32	20	40	16	19	100	100
1 cwt. at Seeding	15	20	14	8	15	28	16	40	20	0	16	19	100	98
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
1 cwt. at Seeding; 1 cwt. in Aug.	19	52	18	0	17	12	15	44	14	40	17	6	99	102
Nil	20	32	18	32	17	28	15	44	13	52	17	14	100	100
2 cwt. at Seeding	19	28	17	36	16	32	14	40	14	56	16	38	97	101

The results obtained over the three years that the experiment has been conducted indicate that the applications of heavy dressings of ammonium sulphate do not give any significant increase in the yields either on fallowed or unfallowed land.

Manganese Experiment.

The object of this experiment is to determine whether the application of a manganese fertiliser in addition to superphosphate would result in increased wheat yields.

At planting time manganese sulphate at the respective rates of 28 and 56 lb. per acre supplemented the superphosphate which was applied at the rate of 112 lb. per acre. These two plots were compared with the control plot, which received the superphosphate only.

The land had been ploughed for the experiment during June, 1930. It was springtyne cultivated in September, harrowed after rain in early April, and then disc cultivated prior to seeding.

The results of the experiment are shown hereunder:—

MANGANESE EXPERIMENT.

Planted on May 23rd, 1931. Superphosphate—112lb. per acre
Variety—Gluyas Early. Seed—45lb. per acre.

Quantity of Manganese Sulphate per acre.	Computed Yield per acre.										Average Yields per acre, 1931.		Percentage Yield, 1931.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.				
	bus.	lb.	bus.	lb	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%
28lb.	23	28	21	36	20	24	22	0	21	52	21	52	102
Nil (Control)	22	56	20	56	19	44	21	28	22	16	21	28	100
56lb.	22	56	21	28	22	0	21	4	20	8	21	31	100

These results are similar to those obtained at the other experiment farms. They indicate that no substantial increase in yield resulted from the application of a manganese fertiliser under the soil and climatic conditions at the Merredin Experiment Farm.

Oat Variety Trial.

This experiment has been conducted for the past nine years. The variety Mulga, an early dual purpose oat, is used as the control. Only early and mid-season varieties are planted in this experiment as the late maturing varieties have proved unsuitable for the district. The experiment is divided into hay and grain sections and includes six varieties.

The yields obtained from both hay and grain sections are given below:—

OAT VARIETY TRIAL.

GRAIN SECTION.

Planted on 8th May, 1931. Seed—40lb. per acre. Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per acre.						Average Yields per acre. 1931.		Percentage Yields, 1931.	Average Yields. per acre, 1930-31.		Percentage Yields, 1930-31.
		Sec. 1.		Sec. 2.		Sec. 3.							
		bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%	bus.	lb.	%
Mulga ...	Early ...	37	32	37	32	46	8	40	24	100	38	2	100
Gidgee ...	Midseason ...	37	8	38	24	39	0	38	11	94	37	27	99
Guyra ...	Midseason ...	43	16	39	32	44	16	42	21	106	40	29	104
Mulga ...	Early ...	39	32	40	0	40	32	40	8	100	39	2	100
Mulga ...	Early ...	36	24	43	32	46	0	42	5	100	39	16	100
Palestine ...	Early ...	38	16	39	8	40	24	39	16	94	41	0	104
Belar ...	Midseason ...	40	0	39	24	42	16	40	27	97	35	37	90
Mulga ...	Early ...	40	24	42	24	43	0	42	3	100	40	4	100
Burt's Early...	Early ...	36	32	43	24	42	24	41	0	93	42	9	103
Mulga ...	Early ...	37	34	50	0	44	16	44	0	100	40	36	100

OAT VARIETY TRIAL.

HAY SECTION.

Planted on 8th May, 1931. Seed—40lb. per acre. Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per acre		Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930 31.	Percentage Yields, 1930-31.
		Section 1.	Section 2.				
		C. Q. L	C. Q. L.	C. Q. L	%	C Q. L.	%
Mulga	Early	62 1 20	60 2 24	61 2 8	100	59 1 2	100
Gidgee	Midseason ...	71 1 12	67 3 20	69 2 16	113	73 3 0	124
Guyra	Midseason ...	62 3 20	64 1 4	63 2 12	103	58 3 10	102
Mulga	Early	60 2 24	63 1 12	62 0 4	100	57 3 0	100
Mulga . ..	Early	57 1 12	54 0 8	55 2 24	100	56 2 20	100
Palestine ..	Early	46 3 12	44 2 16	45 3 0	82	51 2 8	91
Belar	Midseason ...	61 3 4	62 0 8	61 3 20	113	59 0 2	108
Mulga	Early	53 2 24	55 1 20	54 2 8	100	54 3 16	100
Burt's Early ...	Early	58 3 20	54 0 24	56 2 8	102	56 1 14	100
Mulga	Early	55 3 4	55 2 8	55 2 20	100	56 1 16	100

In 1930 the arrangement of this experiment was altered to facilitate the harvesting operations, and in consequence the average results of the last two years only are shown.

This year, in the grain section, all varieties gave similar yields, the highest average yield of 44 bushels being obtained from the early variety, Mulga, which is used as control. It will be noticed that Burt's Early has proved very satisfactory during the last two years.

In the hay section the highest yield was again obtained from the midseason variety, Gidgee, which has proved satisfactory in previous years.

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FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

WONGAN HILLS LIGHT LANDS FARM.

I. THOMAS, Superintendent of Wheat Farms.

A. R. VENTON, Farm Manager.

The season generally has been a very satisfactory one and all varieties of wheat exceeded expectations. The rainfall for the growing period was again below the average, as shown on the following table, but it was well distributed and the spring rains were good.

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
1931	...	9	6	101	209	174	265	174	143	73	1,038	...	137	1,291
1930	7	...	53	92	66	367	321	149	90	55	1,048	1	98	1,299
18 years—Average	41	53	92	64	197	298	272	194	127	93	1,161	39	54	1,524

Many frosts were experienced, but apparently little harm was done to the crop. Useful rains fell in April, and those varieties planted during that month obtained a good start.

The crops sown during the latter half of May were somewhat handicapped by cold conditions prevailing during the following two months. The good rains and the generally favourable conditions during the late spring were of particular advantage to the late planted crops. A few small patches of the disease, Septoria, were noticed in the early sown Nabawa wheat, but the crop, generally, was very healthy and no empty heads were observed.

The land on which the experiments were carried out is mainly of the tussocky smoke bush type, with some gravelly patches at the North end, chiefly affecting the Time of Planting Experiment and the April portion of the Seasonal Variety Trial, with some light sandy patches at the South, chiefly affecting the June portion of the Seasonal Variety Trial and the Rhenania Experiment.

It was fallowed with the sundercut in June-July, 1930, cross ploughed with the same implement in September, and lightly disced in the following March, also with the same implement. It was tandem disc harrowed in front of the drill, these operations leaving a good seed bed, free from suckers.

Time of Seeding Experiment.

This experiment is being conducted to determine the most suitable month for planting the wheat crop in this district.

The early maturing variety, Gluyas Early, and the midseason-Maturing variety, Nabawa, were used, the former being planted mid-May, June and July, and the latter in April, May and June.

The April sown plots germinated well and were healthy throughout the season. The May sown plots also germinated well, and were also healthy throughout the season, but were considerably behind the April plots in general appearance until the early spring, when growth was very rapid. At maturity the May sown plots of both varieties were very slightly taller than the April sown Nabawa plots, and the ears of the May sown Nabawa were slightly bigger and better filled.

The June and July sown plots were, as usual, rather slow in germinating, and were very poor indeed until early spring, when the June sown plots made very rapid growth and improved greatly, but, at maturity, were still behind the May plots, particularly in length of straw. The July plots also improved during the spring, but were very much inferior to the June plots.

TIME OF PLANTING EXPERIMENT.

Variety—Nabawa. Superphosphate—150lb. per acre. Seed—45lb. per acre.

Planted:	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per Acre. 1931.		Percentage Yields, 1931	Average Yields per Acre. 1928–31.		Percentage Yields, 1928–31.
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%	bus.	lb.	%
April 16th	16	0	17	36	18	0	17	4	16	56	17	7	89	16	26	103
May 16th	19	28	19	44	19	52	18	48	18	16	19	14	100	15	56	100
June 16th	14	32	16	40	15	20	15	52	13	28	15	10	79	9	0	57

TIME OF PLANTING EXPERIMENT.

Variety—Gluyas Early. Superphosphate—150lb per acre. Seed—45lb. per acre.

Planted.	Computed Yields per Acre. Sec. 1.		Sec. 2		Sec. 3.		Sec. 4.		Sec. 5		Average Yields per Acre 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928–31.		Percentage Yields, 1928–31.
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%	bus.	lb.	%
June 16th . .	16	0	18	32	18	56	18	48	19	12	18	18	94	10	11	66
May 16th	18	24	19	12	20	0	19	28	20	0	19	25	100	15	23	100
July 16th .	8	24	9	52	10	56	10	24	12	32	10	26	54	6	20	41

The results again confirm those of former years, viz., it is essential for seeding operations to be completed by the end of May.

Rate of Seeding Experiment.

As was the case in prevoius years, the experiment was conducted with two varieties, Nabawa (midseason maturing), representing the free stooling, and S.H.J. (early maturing), representing the sparse stooling types respectively.

The results obtained are shown hereunder:—

RATE OF SEEDING EXPERIMENT.

Planted on 18th May, 1931. Variety—Nabawa. Superphosphate 150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.		Average Yields per acre, 1931.		Percentage Yields, 1931	Avearge Yields per Acre. 1925–31.		Percentage Yields, 1925–31.
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
60lb.	19	12	20	24	20	16	20	56	20	24	20	14	103	15	46	103
45lb.	18	24	20	8	19	44	20	0	20	24	19	44	100	15	21	100
90lb.	19	20	20	48	20	32	20	24	21	12	20	27	104	15	41	102

RATE OF SEEDING EXPERIMENT.

Planted on 10th May, 1931. Variety—S.H.J. Superphosphate—150lb. per Acre.

Rate of Seed per Acre.	Computed Yields per Acre.										Average Yields per Acre, 1931.		Percentage Yields, 1931.	Average Yields per acre 1925-31.		Percentage Yields, 1925-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
60lb.	14	0	13	36	14	8	15	52	16	48	14	53	99	12	34	102
45lb.	14	48	13	52	14	56	15	12	16	0	14	58	100	12	19	100
90lb.	14	0	14	48	15	20	16	32	16	24	15	25	103	13	1	106

Neither the results for 1931 nor the average results indicate any advantage through increasing the amount of seed sown above 45 lb. per acre, either of the free stooling or of the sparse stooling varieties.

Time of Application of Superphosphate Experiment.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during the late summer and early autumn.

For the purposes of the experiment, three plots were required.

Plot 1 received 75 lb. in March and 150 lb. at seeding.

Plot 2 was treated as control and received the whole 225 lb. in March.

Plot 3 received 150 lb. in March and 75 lb. at seeding.

Germination was good and growth healthy and robust on those plots which received a dressing of superphosphate at seeding. Germination and growth generally were somewhat uneven where no superphosphate was applied at seeding, but as the season advanced this became less apparent.

At maturity the whole experiment was very attractive generally, and only a very close examination showed that the control plots were slightly inclined to be uneven in growth.

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 1st May, 1931. Superphosphate—225lb. per Acre. Seed—45lb. per Acre.
Variety—Nabawa.

Time of Application of Superphosphate.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1928-31.		Percentage Yields, 1928-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
75lbs. in March ; 150lbs. at Seeding	25	12	23	36	24	8	24	40	24	0	24	19	103	19	4	112
225lbs. in March ...	23	44	23	28	23	20	23	36	23	36	23	33	100	16	58	100
150lbs. in March ; 75lbs. at Seeding	23	20	24	0	23	44	23	44	24	16	23	49	101	18	10	107

These results confirm those of last year, viz., that yields are decreased when all or portion of the superphosphate is not applied at seeding time.

Rate of Application of Superphosphate Experiment.

The object of this experiment is to determine the most profitable amount of superphosphate to apply on this type of country.

Two sections of 15 plots each were planted. In No. 1 section the rates of superphosphate were 150 lb., 225 lb., and 300 lb. per acre; and in No. 2, 75 lb., 150 lb., and no superphosphate, each being repeated five times.

Germination throughout the experiment was fairly even, but from the time the plants were just above the ground, the plots without superphosphate made absolutely no growth until the spring and many of the plants died. Very few of the plants produced grain, and were only from 4 in. to 6 in. high.

Owing to a mistake, the whole experiment was about 20 inches to one side, and therefore a narrow strip of the plot which received no superphosphate overlapped a portion of those plots which received superphosphate two years before. The plants on this portion grew considerably better than on the remainder of the plot, thus showing the valuable residual effect of the superphosphate applied two years earlier.

There was very little difference between the three heavy dressings at any time during the season, growth and general appearance being excellent. The light dressing (75 lbs.) was much inferior, and showed the effects of the cold conditions.

At maturity the two heaviest dressings were about equal in appearance, and were very slightly better than the 150 lb. dressing.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No 1 SECTION.

Planted on 1st May, 1931. Variety—Nabawa Seed—45lb per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929-31.		Percentage Yields, 1929-31.
	Sec 1.		Sec 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus	lbs.	bus.	lbs	bus	lbs.	bus.	lbs.	%	bus.	lbs	%
225lbs. . .	21	52	22	32	23	4	23	36	23	28	22	54	111	15	53	107
150lbs.	19	36	20	32	20	24	20	48	21	36	20	35	100	14	48	100
300lbs.	22	48	22	56	23	28	24	16	24	24	23	34	115	16	12	109

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No. 2 Section

Planted on 7th May, 1931. Variety—Nabawa Seed—45lb. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre										Average Yields per acre 1931.		Percentage Yields, 1931.	Average Yields per acre, 1929-31.		Percentage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec 4.		Sec. 5.							
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%	bus.	lb.	%
No Super	...		..		. .		...		...		.		...	...		...
150lb.	16	8	13	44	14	0	17	20	17	36	15	46	100	13	13	100
75lb.	9	36	10	32	9	52	10	40	12	8	10	34	67	9	39	73

This year's results again show that although it is advantageous to apply considerably more than 75 lb. of superphosphate per acre on this class of land, it is not profitable, due to the prevailing price of wheat, to exceed an application of 120 lb. per acre.

Rhenania Phosphate Experiment.

Rhenania phosphate is a phosphatic fertiliser manufactured by the Kali-Chemie Company, Berlin, Germany. It is a high grade ammonium citrate soluble fertiliser, containing 28.4 per cent. ammonium citrate soluble phosphoric acid, and has given satisfactory results in Germany. It has also proved valuable for rice culture in Japan and there is a considerable export to that country and also to Brazil, Chili, Guatemala, etc.

Owing to the generosity of the manufacturers, a quantity of this fertiliser was made available for trials in this State. The cost of this fertiliser in Germany is £5 3s 9d. per 1,000 kilograms.

A portion of this fertiliser was made available to this Branch for trials with wheat, and experiments were laid down at both the Merredin Experiment Farm and the Wongan Hills Light Lands Farm.

Plot 1—Received an application of 150 lbs. of Rhenania phosphate per acre.

Plot 2—Received an application of 150 lb. of superphosphate per acre (control plot).

Plot 3—Received an application of 110 lb. of Rhenania phosphate per acre.

Plots 1 and 2 thus received the same weight of fertiliser per acre, and Plots 2 and 3 the equivalent quantities of phosphoric acid.

The plots, which were each one-eighth of an acre in area, were repeated five times, the fertiliser being applied with the seed at the time of planting, and the resulting crop was harvested for grain.

Germination was about equal on all plots, but as the season advanced, the plots which received a dressing of Rhenania phosphate gradually fell behind the controls in general appearance, and also showed the effects of the cold conditions. They made less growth and matured a few days later than the controls. The difference between them and the controls, however, was not nearly so marked as was the case last year. This year's experiment was conducted on land which had previously been cropped and therefore received the benefit of the residual effect of superphosphate which is considerable.

RHENANIA PHOSPHATE EXPERIMENT.

Planted on 7th May, 1931. Variety—Nabawa. Seed—45lb. per acre.

Rate of Application of Phosphates per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average Yields per acre, 1930–31.		Percentage Yields, 1930–31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
150lbs. Rhenania Phosphate	18	24	18	16	17	28	14	40	11	4	15	58	82	12	45	69
150lbs. Superphosphate	23	36	21	36	20	40	17	36	13	44	19	26	100	18	22	100
110lbs. Rhenania Phosphate	17	44	16	48	15	4	11	4	10	48	14	18	74	11	22	62

The results confirm last year's, viz., Rhenania Phosphate is not likely to displace superphosphate as a phosphatic fertiliser for the wheat crop.

Potash Experiment.

The object of this experiment is to determine whether any advantage is derived by supplementing the dressing of superphosphate with a potassic manure for growing a wheat crop on light land.

Three fertilisers were used, and were applied as follows:—

Plot 1—150 lb. superphosphate plus 56 lb. muriate of potash per acre.
Plot 2—150 lb. superphosphate per acre (control).
Plot 3—150 lb. superphosphate plus 140 lb. kainit per acre.

This section of plots, each one-eighth of an acre, was repeated five times. The quantity of potash stated as K_2O is the same in 56 lb. of the muriate as in 140 lb. of the kainit.

The potassic fertilisers were applied to the respective plots about four weeks before seeding. This course is considered advisable owing to the risk of injuring the young plants incurred by applying a fertiliser of this type at seeding time.

Germination was good and growth throughout the season was robust and healthy. At no time during the season could any difference be discerned between the plots.

MIXED FERTILISER EXPERIMENT.

Planted on 1st May, 1931. Superphosphate—150lb. per Acre. Seed—45lbs. per Acre. Variety—Nabawa.

Potash Applied per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931		Percentage Yields, 1931.	Average Yields per acre, 1927–31.		Percentage Yields, 1927–31.
	Sec. 1.		Sec 2.		Sec. 3		Sec. 4.		Sec. 5							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus	lbs.	bus.	lbs.	%	bus	lbs.	%
Muriate of Potash, 56lbs.	19	4	15	12	19	36	17	41	16	56	17	42	97	15	46	98
No Potash	19	4	19	44	19	20	16	56	16	16	18	16	100	16	0	100
Kainit, 140lbs. .	18	0	19	4	18	48	16	24	16	24	17	44	97	15	54	99

The results of this year and also the average results for the five years during which the experiment was conducted, show that the yields are not increased by applying a potassic fertiliser to this class of soil.

Nitrogen Experiment.

The objects of this experiment which was carried out on fallowed and unfallowed land are:—

(a) To determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate, and

(b) To ascertain whether it is advantageous to apply only part of this nitrogenous fertiliser at seeding time and part during the month of August (spring).

For the purposes of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. respectively.

Superphosphate was applied to all plots at the rate of 150 lb. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwt. of sulphate of ammonia per acre respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding in the one instance, and also, in separate plots, the application of half of the sulphate was delayed until the month of August.

NITROGEN EXPERIMENT.

FALLOW—SECTION NO. 1.

Planted on 8th May, 1931. Superphosphate—150lbs. per Acre. Seed—45lbs. per Acre. Variety—Nabawa.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
½ cwt. at Seeding; ½ cwt. in August	26	8	26	0	25	36	25	52	25	52	25	54	140	135
Nil	18	32	18	8	18	0	18	32	19	4	18	27	100	100
1 cwt. at Seeding; 1 cwt. in August	25	28	26	8	26	16	25	36	26	24	25	58	141	142

FALLOW—SECTION NO. 2.

Planted on 8th May, 1931. Superphosphate—150lbs. per Acre. Seed—45lbs. per Acre. Variety—Nabawa.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1029-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
1 cwt. at Seeding	22	40	23	28	22	48	22	56		*	22	58	111	180
Nil	20	24	20	32	19	52	20	24	22	0	20	38	100	100
2 cwt. at Seeding	25	4	26	0	25	20	26	16	25	12	25	34	124	135

* Mishap during harvesting.

NON-FALLOW—SECTION NO. 1.

Planted on 22nd May, 1931. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—150lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs	%	%
½ cwt. at Seeding; ½ cwt. in August	17	36	17	44	17	44	19	4	17	28	17	55	124	119
Nil	13	28	13	52	14	48	14	24	15	28	14	24	100	100
1 cwt. at Seeding; 1 cwt. in August	22	0	21	52	22	32	22	8	23	44	22	27	156	127

NON-FALLOW—SECTION NO. 2.

Planted on 22nd May, 1931. Variety—Gluyas Early. Superphosphate—150lbs. per acre. Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Average centage Yields, 1929-31.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
	bus.	lb.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
1cwt. at Seeding	20	0	20	24	20	24	17	52	19	4	19	33	135	119
Nil	16	32	15	36	13	28	13	4	13	36	14	27	100	100
2 cwt. at Seeding	24	8	23	44	23	20	22	24	23	12	23	22	162	127

The results from the fallowed sections of the experiment show that a dressing of nitrogenous fertiliser when applied at seeding time gives greater yields than when portion is applied at seeding and the balance during spring.

They also demonstrate that this class of soil is very deficient in nitrogen.

This year's results indicate that further increased yields are obtained by applying even more than 1 cwt. and up to 2 cwt. of sulphate of ammonia per acre, but this is not confirmed by previous years' results.

Manganese Experiment.

The object of this experiment is to determine whether increased wheat yields are obtained by applying a manganese fertiliser to the wheat crop. Manganese sulphate was applied at two rates, viz., 26 and 52 lb. respectively, the plots being manured as follows:—

Plot 1—150 lb. superphosphate plus 26 lb. manganese sulphate per acre.
Plot 2—150 lb. superphosphate per acre (control).
Plot 3—150 lb. superphosphate plus 52 lb. manganese sulphate per acre.

The results obtained are shown below:—

MANGANESE EXPERIMENT.

Planted on May 18th, 1931. Superphosphate—130-139 lbs. per acre.
Variety—Nabawa. Seed—45lbs. per acre.

Quantity of Manganese Sulphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus lbs.	bus. lbs	bus lbs	%
26lbs.	19 28	18 32	17 52	16 8	16 56	17 47	100
Nil (Control)	17 28	17 44	15 36	16 0	15 4	16 22	100
52lbs.	19 20	18 40	16 48	16 48	17 28	17 49	100

These results, which are for one year only, show a slight increase in yield by applying manganese sulphate. Similar experiments at the other experiment farms, however, do not indicate that any substantial increase in yield would result from the application of a manganese fertiliser. The value of the increased yield obtained at the Wongan Hills Farm would be far below the value of the applied manganese sulphate.

Seasonal Planting Experiment.

The objects of the experiment are:—

1. To ascertain the most suitable month to plant the late, midseason, and early maturing varieties of wheat.
2. To determine the most prolific of each of the above types.

To meet the requirements of the experiment, three sections were planted, viz.:—

(a) Section 1, planted in April, representing early planting.
(b) Section 2, planted in May, representing midseason planting.
(c) Section 3, planted in June, representing late planting.

Each section, planted in its respective month, was repeated five times, all plots being eventually harvested for grain.

SEASONAL PLANTING EXPERIMENT.

APRIL PLANTING.

Planted on 17th April, 1931. Superphosphate—150lbs. per acre. Seed—45lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Percentage Yields, 1928-31.
		Sec. 1.	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs	bus. lbs	bus. lbs.	bus. lbs.	bus. lbs	bus lbs.	%	%
Yandilla King ...	Late... ...	18 16	17 20	17 20	17 44	17 4	17 33	114	103
Nabawa ...	Midseason ...	15 28	15 4	15 4	16 8	15 4	15 22	100	100
Sutton	Late	18 0	18 0	17 44	18 8	17 52	17 57	117	*
Bencubbin ...	Midseason ...	18 40	18 8	18 0	19 4	18 32	18 29	120	125†
Nabawa ...	Midseason ..	15 36	15 4	15 28	15 36	15 28	15 26	100	100
Gluyas Early ...	Early ...	14 56	14 24	14 48	14 24	14 24	14 35	94	95

* Planted 1931 only. † Planted 1930-31.

SEASONAL PLANTING EXPERIMENT.

MAY PLANTING.

Planted on 15th to 16th May, 1931. Superphosphate—150lbs. per Acre. Seed—45lbs. per Acre.

Variety.	Maturity.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928–31.
		Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Yandilla King ...	Late .	17	36	13	52	15	12	15	44	14	56	15	28	98	92
Nabawa ...	Midseason ...	19	4	13	36	15	28	14	56	15	44	15	46	100	100
Sutton	Late .	18	24	13	20	13	36	13	52	14	56	14	50	94	*
Bencubbin ...	Midseason ..	16	24	17	20	16	24	16	40	17	4	16	46	107	114†
Nabawa ..	Midseason ...	17	20	15	44	14	40	15	4	15	44	15	42	100	100
Gluyas Early ...	Early .	15	4	15	4	13	52	14	24	14	48	14	38	93	103
Merredin ...	Early ..	15	4	14	32	14	8	14	56	14	40	14	40	84	88
Nabawa ...	Midseason .	17	36	17	20	16	56	17	28	17	52	17	27	100	100
Carrabin ...	Early ..	14	32	15	12	15	36	16	24	...		15	26	89	97
S.H.J.	Early ...	13	20	14	32	14	32	15	4	13	28	14	11	86	86
Nabawa ...	Midseason ..	14	24	16	48	17	4	18	32	15	52	16	32	100	100
Geeralying ...	Very Early	12	0	13	36	15	12	15	20	12	8	13	39	83	80
Nabawa ...	Midseason ...	13	20	16	40	16	24	17	44	14	56	15	49	100	100
Noongaar ..	Very Early	7	44	8	8	8	8	9	44	7	44	8	18	52	61

* 1930-31 only. † 1931 only.

SEASONAL PLANTING EXPERIMENT.

JUNE PLANTING.

Planted on 15th to 16th June, 1931. Superphosphate—150lbs. per Acre. Seed—45lbs. per Acre.

Variety.	Maturity.	Computed Yields per Acre.										Average Yields per acre, 1931.		Percentage Yields, 1931.	Percentage Yields, 1928–31,
		Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Geeralying ...	Very Early	6	48	8	40	12	0	12	56	13	56	10	48	76	81*
Nabawa ...	Midseason ...	9	44	12	16	15	12	16	0	17	36	14	10	100	100
Bencubbin ...	Midseason ...	10	24	13	4	18	0	18	40	19	44	15	58	113	117†
Carrabin ...	Early ...	7	36	10	32	12	48	14	48	14	48	12	6	79	87
Nabawa ...	Midseason ...	9	52	15	20	15	52	18	0	17	44	15	22	100	100
Gluyas Early ...	Early ...	9	4	14	40	14	8	15	12	16	48	13	58	91	91
Merredin ...	Early ...	8	16	14	0	13	36	14	56	15	12	13	12	81	86*
Nabawa ...	Midseason ...	10	48	17	20	16	8	18	0	18	48	16	13	100	100
S.H.J. ...	Early ...	8	0	13	20	13	12	14	24	15	12	12	50	79	81
Nabawa ...	Midseason ...	11	20	17	12	17	44	17	44	17	52	16	22	100	100
Noongaar ...	Very Early...	7	28	11	44	12	48	13	12	11	28	11	20	69	72

* 1929–31. † 1930–31.

In all three sections the midseason variety, Bencubbin, shows to considerable advantage. The late varieties, Yandilla King and Sutton, have also yielded well in the early planted section.

The experiment indicates the advantage of early planting on this class of soil.

Oat Variety Trial.

In former years this experiment consisted of eight sections, three of which were cut for hay and the remaining five harvested for grain. This year, however, all of the eight sections were harvested for grain.

The results are shown hereunder:—

WONGAN HILLS LIGHT LANDS FARM.

OAT VARIETY TRIAL.

Planted on 21st and 22nd May, 1931. Superphosphate—150lbs. per acre. Seed—40lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.																Average Yields per acre. 1931.		Percentage Yields, 1931.	Percentage Yields, 1926–31.
		Section 1.		Section 2.		Section 3.		Section 4.		Section 5.		Section 6.		Section 7.		Section 8.					
		bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	%
Mulga	Early	14	24	10	24	11	8	9	8	13	24	13	24	13	32	16	0	12	33	98	96
Burt's Early	Early ...	13	24	8	16	11	16	12	16	13	16	14	24	15	16	15	16	13	3	100	100
Belar	Midseason ...	11	0	9	32	11	0	13	0	14	0	15	24	16	16	16	8	13	15	102	98
Burt's Early	Early	12	24	9	32	11	32	11	24	12	16	13	24	15	32	17	24	13	6	100	100
Burt's Early	Early ...	12	8	9	8	10	32	11	24	13	16	14	24	16	16	17	24	13	9	100	100
Algerian	Late	10	32	9	32	13	24	14	16	15	16	15	32	17	32	18	24	14	21	110	118
Guyra	Midseason ...	10	32	9	24	14	16	13	32	14	0	14	24	16	8	19	16	14	4	105	107
Burt's Early	Early	11	0	10	8	13	8	11	16	13	8	14	0	16	24	17	24	13	16	100	100
Burt's Early	Early ...	10	32	10	8	12	16	10	8	12	24	14	16	17	0	15	16	12	35	100	100
Lachlan	Midseason ...	12	16	12	8	14	24	16	24	16	24	17	8	18	24	11	32	15	0	117	108
Gidgee	Midseason ...	10	24	10	32	8	24	10	32	12	8	13	8	15	0	14	8	11	37	90	86
Burt's Early	Early	9	32	11	16	11	24	13	32	14	0	14	8	16	8	14	24	13	8	100	100
Burt's Early	Early ...	9	32	10	32	10	32	12	24	13	0	14	32	16	0	12	16	12	21	100	100
Palestine	Early ...	6	32	7	0	7	24	7	0	7	16	8	16	11	24	7	0	7	34	63	101

The late and midseason maturing varieties of oats have shown to best advantage in these trials. However, with the exception of the early variety, Palestine, there is not a great deal of difference between the yields of any of the varieties planted in the trial.

RATE OF SEEDING EXPERIMENT—OATS.

As was the case for the similar experiment with wheat, this was planted with both a free and a sparse stooling variety, and the land also was prepared identically with that for the wheat experiment.

Burt's Early.—Germination was good, and growth was steady throughout the season. Although the light sowing appeared somewhat thin, there was little difference between the two heavier rates. A certain amount of black flag occurred, more particularly on the gravelly soil. At maturity the light sowing was not so dense as the heavier rates, but was very slightly taller.

Algerian.—Both germination and stooling were good. Growth was slow until September when rapid growth was made. A certain amount of black flag occurred, more particularly on the gravelly soil, but was not so marked as in the Burt's Early. The light sowing appeared somewhat thin throughout the season and at maturity did not show to advantage alongside the heavier rates.

RATE OF SEEDING EXPERIMENT—OATS

Planted on 19th May, 1931. Variety—Burt's Early. Superphosphate—150lb. per acre.

Rate of Seed per acre.	Computed Yields per Acre.					Average Yields per Acre. 1931.	Percentage Yields, 1931.	Average Yields per Acre, 1926–31.	Per centage Yields, 1926–31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
45lb.	10 32	13 8	14 0	15 0	14 8	13 18	107	14 1	102
30lb.	11 24	12 16	13 0	14 0	12 0	12 24	100	13 29	100
60lb.	12 0	14 8	14 32	15 24	14 32	14 11	113	14 17	105

RATE OF SEEDING EXPERIMENT—OATS.

Planted on 19th May, 1931. Variety—Algerian. Superphosphate—150lb. per acre.

Rate of Seed per acre.	Computed Yields per Acre.					Average Yields per Acre. 1931.	Percentage Yields, 1931.	Average Yields per Acre, 1926–31.	Percentage Yields, 1926–31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb	bus. lb.	bus lb.	%	bus. lb.	%
45lb.	18 32	20 0	18 32	20 0	19 8	19 14	103	14 12	109
30lb.	19 0	20 16	17 8	17 24	19 32	18 32	100	13 3	100
60lb.	20 32	22 24	19 16	20 32	20 0	20 29	110	14 24	112

With the sparse stooling variety, this year's results would indicate that yields are increased by the heavier rates of seeding, but the average results of the past six years indicate that no economical advantage is gained by sowing the heavier rates of seed.

With the free stooling variety both this year's results and the average for the past six years show that the yields are increased to advantage when the heavier rates of seeding are applied. This is the reverse of what may have been expected and may be due to the sparse stooling variety containing a greater number of seeds per bushel than the freer stooling one which has larger and heavier grain.

DOWNY MILDEW (so-called "Blue Mould") OF TOBACCO.

Found occurring naturally on Wild Tobacco (*Nicotiana suaveolens*) **in the Wheat Belt.**

PRECAUTIONS NECESSARY DURING THE FORTHCOMING SEASON.

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

As previously reported in this Journal by the writer (Vol. 7, 2nd Series, No. 3, pp. 469-476, September, 1930), the first outbreak of the "Downy Mildew" (so-called "Blue Mould") disease of tobacco in this State was recorded on the 14th August, 1930, on tobacco seedlings grown in the South-West at Manjimup. A hurried visit on that occasion to the district by Mr. A. R. C. Clifton, who is in charge of the tobacco investigations in this State, and the writer, revealed that the disease had apparently been present in a mild form unrecognised for several years, having presumably been introduced in the first place by infected seed.

In an attempt to make quite sure that their tobacco seedlings would not be infected with the disease during the 1931-32 season, the growers on whose properties the "Downy Mildew" had appeared the previous season made private arrangements, unknown at the time to the writer, to have their tobacco seedlings raised at Doodlakine in the early zone of the wheat belt, 205 miles in a direct line from Manjimup and about 120 miles in a straight line East and slightly North of Perth. The average annual rainfall is about 13 inches, most

Fig. 1. *a.* (*left*). A young tobacco plant infected with "downy mildew" (blue mould"). Note the shrivelling of the leaves indicated by the arrows.
b. (*right*). Portion of the underneath side of a young leaf infected with "downy mildew" ("blue mould"). Note the whitish, downy, growth of the fruiting-bodies of the causal fungus, *Peronospora sp.* (magnified). *After N S. Wales Dept. of Agriculture.*

of which falls in the period from April to October It was considered by the growers that the fungus causing the disease (*Peronospora sp.*) could surely not be encountered there.

All the seed planted had been disinfected in absolute alcohol for six minutes by officers of this Department, and was taken from the same bulk of disinfected seed as was being drawn on to supply other settlers in the South-

West, none of whom had any signs of "Downy Mildew" in their seedlings or grown plants, so far as is known, during the whole of the season.

On the 15th October, 1931, Mr. Clifton was advised by an interested party that tobacco seedlings which were being sent down to Manjimup from Doodlakine appeared to be affected with "Blue Mould." Mr. Clifton and the writer therefore proceeded to Doodlakine immediately, and found (16th October) that the greater part of one acre of seed beds ("Hickory Prior," "White Stemmed Orinoco," and "Adcock") was exceedingly seriously affected with "Downy Mildew" (*Peronospora sp.*). Searching over the granite outcrops of the district on the following morning, we were able to find large numbers of wild tobacco plants (*Nicotiana suaveolens*), many of which showed the typical whitish patches and fruiting bodies (*conidiophores*) of the *Peronospora* on the lower surfaces of the leaves.

The time at our disposal while waiting for the train was only limited, as it seemed imperative to get down to Manjimup as soon as possible to investigate the situation there and prevent, if possible, an epidemic (*epiphytotic*) of the disease in the South-West. Wild tobacco plants as far away, however, as eight miles from the infected seed beds were examined and found to be carrying the conidiophores of a *Peronospora* which appears to be identical with that on cultivated tobacco. As all of the seed planted in the seed beds at Doodlakine was disinfected in absolute alcohol in the usual way and was from the same bulk as supplied to many other growers in the South-West, none of whom had any losses, so far as is known, from "Blue Mould," it appears pretty clear that the infection on the seed beds at Doodlakine was picked up from the naturally-infected wild tobacco in the district. The seed beds were not fired or disinfected before planting, and some wild tobacco seedlings were actually found growing in the seed beds with the cultivated species.

Fig. 2.—Adult tobacco leaf showing holes in places previously attacked by "downy mildew" ("blue mould") due to *Peronospora sp. After N.S. Wales Dept. of Agriculture.*

Assisted by the very hot, dry weather at Manjimup, we were able to get the disease under control, although the infected seedlings had been planted out on four properties for about a fortnight before we were advised of the occurrence of the disease in the Doodlakine seedlings. Incidentally, it may be mentioned that seedlings being raised at the time on the infected properties at Manjimup were prevented from becoming diseased by having the growers, *inter alia,* spray the seedlings at frequent intervals with Bordeaux mixture and keep the waterings down to the irreducible minimum, while at the same time giving the maximum possible exposure to sunlight and keeping the temperatures up as much as possible at nights.

On the 16th December, Dr. L. J. H. Teakle, Plant Nutrition Officer, brought to my office in Perth a parcel of wild tobacco plants (*Nicotiana suaveolens* var. *major*) which had been collected quite *at random* at Knunjagin in the wheat belt, 20 miles or so North of Merredin and about 35 miles in a direct line North-East of Doodlakine, where the nearest cultivated tobacco had been growing. These plants had not been examined at all in the field for the presence of disease, yet the very first leaf examined in the laboratory was found to be carrying the conidiophores of the *Peronospora*. There is little doubt that a thorough survey of the wild tobacco situation in the wheat belt would reveal the disease to be widespread in our drier wheat belt areas.

Indeed, it is beginning to look very much as if the causal fungus of the "Blue Mould" disease of cultivated tobacco in Australia is indigenous to the Commonwealth, as has been suspected in scientific circles for some time. This would explain why the disease has been such a menace to the Australian tobacco-growing industry right from its inception, although apparently of little, if any, consequence elsewhere.

PRECAUTIONS TO BE TAKEN IN FUTURE TO PREVENT THE DEVELOPMENT OF "DOWNY MILDEW" ("BLUE MOULD") OF TOBACCO.

The writer firmly believes that "Downy Mildew" ("Blue Mould") of tobacco can be prevented, or at least "controlled" in Western Australia, provided that the proper precautions, as indicated below, are taken.

In this connection no single measure can be relied on for success. Control of such a serious pest as the "Blue Mould" can only be achieved by the intelligent combination of a series of interdependent practices. These may be stated as follows:—

1. Under no circumstances should growers attempt to escape the ravages of "Downy Mildew" ("Blue Mould") simply by having tobacco seedlings raised in the wheat belt. To do so, from what has been said above, is obviously to court disaster, not to escape it, owing to the widespread distribution of wild tobacco in the wheat belt and the fact that, at least in certain areas, the wild tobacco is naturally infected with the disease.

2. At the conclusion of the harvesting operations for the season, *i.e.*, when all the seed or leaf has been gathered, every tobacco plant on the property should be destroyed, in order to prevent carrying the fungus over from year to year on over-wintering plants. The best method of destruction would be to pull up the remains of the plants by the roots and burn them, but, if the same field is not to be used again for several years for tobacco-growing, there would be no objection to ploughing the plants under, provided that a mouldboard plough which will completely bury the tissues is used and that any suckers which may happen to grow up are systematically destroyed as soon as noticeable above the ground. Tobacco growers should regard tobacco plants growing on their properties at any other times than when being deliberately grown for seed or leaf as their worst possible enemies, from the point of view of insect and disease dissemination.

Ministerial approval under the Plant Diseases Act, 1914-25, has been obtained to enable the above operation to be rigorously enforced by the end of June at the very latest.

3. The seed beds should be placed in a new position each year, and should be as far as possible removed from curing-barns or places in which tobacco is stored, or fields which have previously grown tobacco.

4. The seed beds should be *sterilised* in one or other of the following ways:—

(a) by the use of steam at 100 lbs. pressure for half an hour by means of the "inverted pan" system; or

(b) by the use of a strong wood fire on the site of the seed bed for at least four hours. (The heat should be sufficient to cook a 4oz. potato buried three inches deep in the soil, or an egg buried five inches deep)*; or

(c) by thoroughly loosening the soil of the seed bed with a spade, etc., and then watering with *formalin solution* made up at the rate of one gallon of commercial formalin to every fifty gallons of water, using half to one and a half gallons of the made-up solution to every square foot of soil. Formalin-moistened bags, or the glass frames or linen covers after being watered with, or dipped in, the formalin solution, should be put on the beds for two days following treatment to hold in the fumes, then removed and the beds stirred and allowed to air for at least 10 days before sowing the seed. When stirring the beds to let out the formalin fumes, after the first two days, or to make a suitable surface on the bed to receive the seed at the completion of the treatment, use a rake or shovel, etc., previously sterilised with steam, fire or formalin.

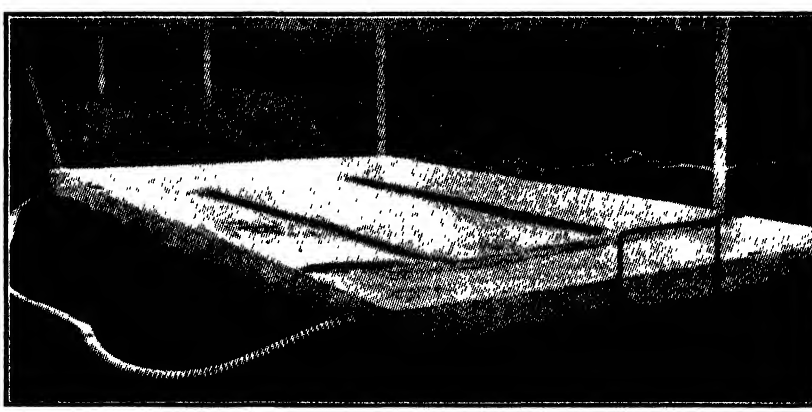


Fig. 3.—Showing a method of sterilising soil by steam, using the "inverted pan" system. Note the flexible steampipe entering the heavy-gauge galvanised iron pan at the front left corner. Note also the handle at the front for lifting the pan from one site to another. The rear handle is hardly obvious in the photograph.—*After Chupp, "Manual of Vegetable Garden Diseases."*

5. All seed sown should be soaked before sowing in absolute alcohol for five minutes to destroy any infection possibly being carried by the seed.

The Department has undertaken to treat all tobacco seed at a cost of one shilling per ounce or part thereof, and, under the Plant Diseases Act, 1914, *the sale or distribution of tobacco seed within the State has been prohibited, unless,*

* N. A. R. Pollock, "Tobacco Seed Beds," Queensland Agric. Journal," Vol. 34, Part 4, pp. 408-412, October, 1930.

and until, the seed has first been disinfected under the supervision of an Inspector under the Act. Under the same Act steps have been taken to have the importation of tobacco seed from other States or Overseas prohibited except for Departmental purposes (see *Government Gazette*, 24th October, 1930). The penalty for disregarding any regulation under the Act is £25.

Disinfection of the seed in absolute alcohol has recently been shown by Angell (Journ. C.S.I.R., Australia, Vol. 2, pp. 150-160, 1929) to be very effective, and this treatment must be considered henceforth a routine practice in tobacco culture. (Departmental experiments have shown that the germination of the seed is not detrimentally affected by as long an immersion as six and one half minutes in absolute alcohol, if the seed is spread out thinly and dried on clean blotting paper, with frequent turning to hasten the evaporation of the alcohol, as quickly as possible following treatment.)

6. Seeing that the "Downy Mildew" or "Blue Mould" is greatly encouraged by abundance of moisture, every precaution should be taken to keep the surface of the seed bed as *dry* as possible after the seeds have germinated. Every effort should be made to reduce the surface waterings to an absolute minimum, or even to eliminate them altogether. This may be done by making the soil very firm during the preparation of the seed bed so that water will readily flow to the roots by capillarity, or by watering, as in the "Marks" system (Report from Select Committee on the Tobacco-growing Industry in Australia, Government Printer, Canberra, 1930), from a trough running along the back of the seed bed with perforated pipes at right angles carrying the water several inches below the surface of the soil.

Overhead watering, if used, should only be carried out in the mornings, never at night, so that the moisture will soon be dried off the leaves by evaporation. The "Downy Mildew" fungus enters the leaves through moisture at night, or during dull, muggy weather; hence the importance of always keeping the above-ground parts of the plants as dry as possible.

Seed beds should be so built as to lie broadside-on to the morning sun. As soon as the seeds have germinated they could be lightly covered with sterilised white sand, and a little of the sterilised sand could be sprinkled on the bed from time to time as the seedlings grew older. The sand could be sterilised by the use of formalin as described under 4 (c) above, or by heating in shallow tins in an oven for several hours, and it could then be stored in sterilised kerosene tins until required.

7. The glass frames, or the linen or hessian covers to the seed beds, should be removed every bright, dry, sunny day so as to cause hardening-up of the seedlings and prevent the steamy conditions so favourable to the "Downy Mildew."

8. The plants should be well thinned out in the seed bed, so that each plant will receive plenty of sunlight and have a good circulation of air around it. Wide spacing of the seedlings avoids the moist, muggy conditions and the soft sappy growth so favourable to the disease.

9. If possible, some source of heat should be provided for the seed beds at night, and during cold days, so as to prevent the temperatures dropping below 45 deg. F., as the development of the fruiting-bodies of the fungus (and consequently its rapid spread) seems to be greatly favoured by low temperatures following warm, muggy, conditions just previously. Some growers make use of a fire with a straight-through or return flue beneath the bed to keep up the temperatures, while others use a kerosene or petrol lamp outside one end of the bed to heat a pipe running through the frames above the seedlings. This would seem to be the best type, as tending to lower the humidity of the air.

above the bed quite considerably, but care must be taken to see that the apparatus cannot get too hot. Moreover, if this method is used, the covers to the seed beds must be erected considerably further above the surface of the beds than is common practice at the present time.

In "The Farmers' Handbook," 5th Edition, published in 1929 by the New South Wales Department of Agriculture, it is stated, "**Experiments conducted by the Department during the last few years indicate that if the temperature of the seedlings is not allowed to fall below 45 deg. F., and the surrounding air is not allowed to become humid, "Blue Mould" does not make its appearance.**

10. Seed beds should be made long and narrow, and not short and broad. About a yard wide should be ample. This type of construction greatly facilitates the work of weeding, transplanting, etc., and there is not nearly so much chance of spreading infection mechanically during inspection of the seedlings.

11. As a precautionary preventive measure the seedlings in the seed beds should be sprayed at five to seven-day intervals with a 3-5-50 Bordeaux Mixture; a very fine mist being used so as to leave only a thin film of spray on the leaves when the liquid has dried down. The spraying should commence as soon as the tiny plants reach the four-leaf stage. Commercial ready-made Bordeaux or Burgundy mixtures can be used instead of the home-made Bordeaux, at the rate of one quarter pound (¼ lb.) to every two and one half gallons of water (2½ gallons). Any of these sprays can be conveniently applied to the seedlings in the seed bed with a knapsack sprayer. Spraying should not be done during the heat of the day or when the plants are drooping. Early in the morning, after the dew has dried off the plants, but before the sun has become too hot, or an hour or so before sun-down in fine, warm, quick-drying weather would be satisfactory.

Leaflet No. 314 on the preparation of Bordeaux Mixture can be obtained without charge upon application to the Department of Agriculture. A full account of the preparation of this excellent fungicide can also be found in the December, 1930, issue of this Journal. Growers should follow the directions very closely, and should be particularly careful only to use the very best freshly burnt or quick lime. Air-slaked lime is useless for the preparation of Bordeaux Mixture. A rough but useful test which should always be made after the Bordeaux Mixture has been prepared, and before spraying the plants with it, is to dip the clean blade of a penknife or a bright piece of iron, such as a shiny nail, into the mixture for several minutes. If the mixture does not contain enough lime, a reddish-brown deposit of copper will form on the iron and more quick lime should be added, until, on further testing with a fresh knife blade or shiny nail, no stain is obtained. If this test is always carried out before spraying with the Bordeaux Mixture, there need be no fear of burning the plants with the spray.

12. Seed beds should be planted as *late* as possible in the spring, as the lower the atmospheric humidity during the growth of the seedlings and following transplanting the less is the danger of loss from "Downy Mildew." Considerably more seedlings should be raised than are actually required for planting out, and a succession of sowings in different seed beds at weekly or fortnightly intervals may be of considerable value in ensuring that some at least will come through to planting-out time unscathed.

13. If possible, tobacco should not be grown more frequently than, say, once in three years on the same paddocks, as the fungus, in the resting-spore (*oospore*) stage, can apparently remain alive in the soil for a long period.

14. In the event of "Downy Mildew" breaking out in the field, the plants should be sprayed with Bordeaux Mixture 3-3-50 plus ½ lb. calcium caseinate to every 50 gallons of spray, taking great care to see that the bottom sides of the leaves are thoroughly sprayed. (Preparation of Bordeaux Mixture is fully described in Leaflet No. 314, available, free of charge, on application.) Instead of spraying, the plants could be dusted with a recognised copper carbonate-sulphur or copper sulphate-lime dust, although spraying will be found more effective than dusting.

15. Should any plants in the seed beds become affected with "Downy Mildew," they, and the immediately-surrounding plants, should be destroyed *before removing* from the bed by watering with a little strong bluestone solution made up at the rate of 1 lb. to 1 gallon of water. After the plants are dead, or thoroughly wet with the bluestone on the bottom sides of the leaves, they should be removed and burned, or deeply buried.

16. All precautions should be taken to keep down insect pests, as these are very liable to carry infection into the bed from neighbouring farms or from plant to plant in the beds. Angell (Journ. C.S.I.R., Australia, Vol. 3, pp. 83-86, 1930) has recently shown that the "potato moth" or "tobacco leaf miner" (*Phthorimaea operculella*, Zell.) can readily carry infection, and the same undoubtedly applies to other insects such as the "lucerne flea" (*Smynthurus viridis*, Linn.) or the "red legged earth mite" (*Penthaleus destructor*, Jack.), etc.

A space free of all vegetation should be left for several yards around the tobacco beds, as this will act as a good break to the lucerne flea, mite, and other similar walking or hopping insects.

17. Growers should refrain from visiting other growers' seed beds, as one careless human might carry considerably greater numbers of fungus seeds (*spores*), and for much greater distances, than many insects.

18. All "native tobacco" plants (*Nicotiana suaveolens*) or other wild tobacco species on a tobacco plantation, or in a tobacco-growing district, should be periodically destroyed, as they may harbour the "blue mould" fungus.

19. Care should be taken to avoid dropping cigarette-ends or fragments of cut leaf from commercial smoking mixtures, especially if air-cured, on the seed beds or tobacco fields, as it is possible that infection may occasionally be carried in that way.

20. The seedlings should be transplanted into the field *as soon as possible*, as the "Downy Mildew" ("Blue Mould") disease is essentially a seed bed trouble, being favoured in the seed bed by the unnatural crowding of the plants and the somewhat artificial conditions under which they are grown while in the seed bed stage. Little, if any, trouble will be caused by this disease in this State in normal years after planting out.

A full description of the symptoms of "Downy Mildew" ("Blue Mould") of tobacco, together with the life-history of the causal fungus (*Peronospora sp.*), may be found in Leaflet 329, available, free of charge, on application to the Department of Agriculture, or on pages 264-72 of this Journal for June, 1931.

FINAL WORD.

All the above may seem a lot of trouble to go to, but there is no doubt that the successful Australian tobacco-grower of the future will be he who never tires of going to what other people would call trouble, to ensure successful results. The rewards for successful tobacco culture in Australia are great, but nature certainly seems to be doing her best to ensure that the rewards shall not be too easily won. Biological laws are no less immutable, or less certain in their outcome, however, than physical ones, and he who correctly sets the stage in every detail must inevitably reap the reward.

THE APPLE CURCULIO.

ITS CONTROL BY A POISON BAIT.

By H. G. ANDREWARTHA, B.Sc. (Agric.).

During the past summer the depredations of the Apple Curculio (*Otiorrhynchus cribricollis*) have been as serious as ever. This pest is rapidly spreading throughout the fruit growing districts. In those orchards in which it is well established (and their number is dangerously on the increase) the damage to the trees has been very severe. The fruit spurs and leaders have been ring-barked, the buds have been eaten, and the foliage has been destroyed. For this reason it behoves those growers whose orchards are infested to take prompt and thorough steps for its control.

Fortunately, as the result of a special investigation by the Entomology Branch of this Department, we are now in a position to recommend a very cheap and efficient measure for its control. This bait which has been evolved during the investigation into the bionomics of this pest is undoubtedly the most efficient and cheapest method yet tried (for other control measures see this *Journal*, March, 1930). The bait consists of Sodium Fluoride (a poisonous white powder) mixed with reject apples which have previously been dried and minced. The formula is—

Dried Apple (minced)—9lbs.

Sodium Fluoride—1lbs.

The bait is spread as a complete ring around the butt of the tree. It is essential to place the bait as close to the butt as possible and to make a complete ring of it. The beetles have thus to crawl over the bait before they ascend the tree, and, in so doing, they eat it and are thereby destroyed.

The *time of application* of the bait is a very important factor in its success, and consequently it cannot be too strongly stressed. The reason for the need of exercising care in the time of applying the bait lies in the peculiar feeding habits of the pest. It feeds during two periods which are separated by a long quiescent spell during which no damage is done. The first spell of feeding commences at the beginning of December and lasts until the first week in January, during which time the trees may suffer very serious defoliation if the weevils are numerous. The quiescent spell lasts all January and for the first half of February. During this time the old scars callouse and no fresh damage is to be observed. The second "burst" of feeding commences about the middle of February and lasts throughout March and April. All this time there is only a short period—the first two or three weeks of December—during which all the weevils are feeding every night. During the later feeding period the feeding is much more prolonged and irregular.

Several conclusions as to the correct time to apply the bait can be drawn from the above brief description of the habits of the Curculio. In the first place, the most vulnerable time in its life is the *first few weeks of December*. At this time the weevils have just emerged from their larval stage and are all feeding ravenously. Consequently *the best time to apply the bait is during the last week of November and not later than the first week of December*. In the second place, it is obvious that no good can come from bait that is applied late in December or during January. *During this time the weevils are hiding below the surface—and*

not feeding. Thirdly it follows that if the first baiting is not 100 per cent. effective (and it is hardly likely to be), one can expect to see a renewal of the damage starting about the middle of February. If such damage is observed it will be necessary to make a second application of the bait. The time for the second treatment is the third week in February.

As there are normally no apples available for drying in November, it will be necessary to store the bait in the prepared form. It could very readily and easily be prepared from windfall or reject apples when these are plentiful during the months from February to April. These should be roughly cut up, dried, minced and mixed with the poison as directed above. The bait so prepared can be stored in tins or boxes and will keep in perfect condition through the winter. It is estimated that from 10-15 lbs. of bait will be required for each acre of orchard to be treated. It is necessary to dry 6 lbs. of fresh apple for every 1 lb. of the dried material required. Two applications of the bait will probably be necessary. Consequently the orchardist will need to dry 120-180 lbs. of fresh apples for every acre he proposes to treat. This allows 60-90 lbs for each treatment.

The cost of making and applying 10 lbs of bait is estimated as follows:—

Cost of materials—	
Sodium Fluoride (1 lb.)	2s. 5d.
Dried Apple (9 lbs.)	Nil.
Cost of labour—	
Drying and mincing apple (1 man for 2 hours)	2s. 6d.
Applying bait (1 man for 1 hour)	1s. 3d.
Total	6s. 2d.

Assuming that 15 lbs. are required for 100 trees, the cost on these figures will be about 1d. per tree per dressing. This method is thus far cheaper than any other tried out to date and has the additional advantage of being a very efficient control of the pest.

SUMMARY.

The most effective control of the Apple Curculio is poison baiting.

It is essential that the bait be applied at the right time.

The best time is the last week in November and not later than the first week of December.

It may be necessary to repeat the treatment in the third week of February.

It is quite useless applying the bait during the quiescent spell which lasts from the end of December to the middle of February.

It will be necessary to prepare the bait in the autumn and store it through the winter.

LOCAL CROP COMPETITIONS, 1931.

I. THOMAS, Superintendent of Wheat Farms.

In addition to the 50-acre Crop Competitions conducted by the Royal and District Agricultural Societies, competitions were also conducted by unaffiliated bodies or by agricultural societies who submitted their entries too late for acceptance by the Royal Agricultural Society.

The district agricultural societies of Dalwallinu, Kukerin, and Phillips River each conducted competitions judged according to the Royal Agricultural Society's conditions. The competition conducted by the Karloning Progress Association differed inasmuch that it was not a condition that the crop should necessarily be planted on fallowed land.

In all there were 39 entries, the average yield for all competitors being 21.9 bushels. The average yields for the competitors on fallowed and unfallowed land were as follows:—

Fallowed	23.5 bushels
Unfallowed	13.5 „

The judges' reports and awards, together with a detailed summary of the cultural details will be found on the following pages.

DALWALLINU AGRICULTURAL SOCIETY.

Judge—I. THOMAS, Superintendent of Wheat Farms.

This Society is located in Zone 2, but the entries were received too late for inclusion in the Zone Competition.

Six crops were submitted for inspection, the awards being as follow:—

DALWALLINU DISTRICT AGRICULTURAL SOCIETY, 1931.

Judge—I Thomas, Superintendent of Wheat Farms.

Competitor	Address.	Variety	Yield. 50 pts.	Freedom from Weeds 10 pts.	Freedom from Disease. 10 pts.	Freedom from Admixture. 15 pts.	Evenness of Growth. 15 pts.	Total 100 pts.
Sutcliffe, J. & G.	Damboring ...	Gluclub ...	38	8	8	13	14	81
Locke, F. C. ..	Dalwallinu ...	Merredin ...	31	7	7	13	13	71
Bonner, R. J. ...	Nugadong ...	Gluyas Early	29	7	8	12	14	70
Bradford Bros.	Damboring ...	Gluyas Early	29	8	6	14	13	70
Manuel, J. ...	E. Buntine ...	Ford ...	26	8	8	12	13	67
Owen, G. H. ...	W. Buntine ...	Merredin ..	20	9	9	13	13	64

The rainfalls, as recorded at the Dalwallinu centres, are set out below:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sep.	Oct.	Total.	Nov.	Dec.	Total for year.
Dalwallinu ...	...	142	9	86	285	112	251	191	170	121	1,130	165	25	1,557
E. Buntine ...	...	47	1	77	189	99	136	130	104	53	711	61	64	961
Damboring (Ballidu)	...	15	5	94	234	112	312	195	160	61	1,074	...	38	1,226

The cultural details of the competing crops are summarised below:—

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations	Variety.	Planted	Rate of Seed.	Rate of Super.	Seed treatment.	Graded.	Disease.
						in				lbs	lbs.			
Sutcliffe, J. G.	? Old land	Salmon gum and gimlet	June-July	Good	Disc	3½	Springtyne cultivated Aug., again in Sept., and again in Oct. Planted with combined cultivator drill	Gluclub	3rd week April	38	90	Copper carbonate	Yes	Traces Ball Smut, Flag Smut, and Takeall.
Locke, F. C. ...	6	Salmon gum, gimlet and little morrel	June	Good	Mouldboard	3½	Springtyne cultivated end Aug. and again Sept. Harrowed after rain in Feb. Planted with combined cultivator drill	Merredin	End April and early May	37	90	Copper carbonate	Yes	Flag Smut and patches Takeall.
Honnor, R. J.	6	Heavy salmon and gimlet	July	Good	Mouldboard	4	Springtyne cultivated Sept., and again in Oct. Planted with combined cultivator drill. Fed off with sheep till 3rd week in June	Gluyas Early	1st week in May	45	112	Copper carbonate	Yes	Little Takeall.
Bradford Bros.	? Old land	Salmon gum, little morrel	End June, early July	Good	Disc	3½–4	Springtyne cultivated Sept., and again after rain in Feb. Planted with combined cultivator drill	Gluyas Early	Mid-May	45–50	90	Copper carbonate	Yes	Flag Smut.
Manuel, J. ...	8	Gimlet, York gum, and jam	June	Good	Disc	3½	Springtyne cultivated July and Aug. Planted with disc drill	Ford	Mid-April	60	90	Copper carbonate	Re-cleaned	Slight trace Flag Smut and Takeall.
Owen, G. H.	New land	Smokebush and tussock	June	Good	Disc	5	Tandem disced in Mar. and harrowed immediately after seeding. Planted with disc drill	Merredin	End 1st week May	40	116	Copper carbonate	Yes	Little Septoria

BRUCE ROCK FALLOW AND CROP COMPETITION.

Judge—G. L. THROSSELL, Agricultural Adviser.

In addition to the competition included in the Zone Competitions, the Bruce Rock Agricultural Society conducted a local crop competition. It was stipulated that crops entered in this must be grown on fallow which had been judged earlier in the year (see Journal, June, 1931, p. 195), and the places allocated on the combined number of points from both sections of the competition.

Six crops were inspected, awards being made as follows:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge—G. L Throssell, Agricultural Adviser.

Competitor	District.	Variety	Yield 50 pts	Freedom from Weeds. 10 pts	Freedom from Disease. 10 pts.	Freedom from Admixture 15 pts.	Evenness of Growth 15 pts.	Crop. 100 pts.	Fallow. 100 pts.	Total. 200 pts.
Allen Bros ..	Central Kumminin	Gluclub	31	9	9	12	14	75	89	164
Schilling, C. E. and N. S.	Bungulluping	Gluclub	29	9	9	12	13	72	91	163
Smith, C. & Sons	Yarding .	Gluclub	29	8	8	13	13	71	92	163
Brown, S A.	Bungulluping	Gluclub	28	8	8	12	13	69	93	162
Farrall, F C. & Sons	Yarding	Gluclub	29	8	8	12	13	70	87	157
Strange, P A	Yarding .	Caliph	22	9	8	13	13	65	85	150

The following table shows the rainfalls, as recorded at the centres concerned in the Bruce Rock competitions.

——	Jan.	Feb.	Mar	Apl.	Growing Period. May.	June.	July.	Aug.	Sep.	Oct	Total.	Nov.	Dec.	Total for year.
Yarding (Rosedale)	...	...	39	53	200	129	234	302	117	52	1,034	13	51	1,190
Emu Hill ..	.	...	11	114	259	148	247	320	132	36	1,142	...	..	...
Bruce Rock .	.	..	9	160	221	134	216	325	142	44	1,082	16	54	1,321

The cultural details of the competing crops are set out below:—

CULTURAL DETAILS.

Competitor.	When Cleared.	Rotation.	Timber	When ploughed.	Implement.	Depth.	Condition of land	Subsequent cultivations	Variety	Planted.	Rate of Seed.	Rate of Super.	Diseases.
						in					lb.	lb.	
Allen Bros. ...	1927	2 years Fallow, Wheat	Gimlet	End June	Disc cultivator	3	Good	Springtyne cultivated Aug	Gluclub	3rd week April	45	100	Trace Takeall.
Schilling, C. E., & N. S.	1922	2 years Fallow, Wheat	Salmon and gimlet	June	Mouldboard	3	Good	Harrowed end June, skim ploughed early Aug Springtyne cultivated early Sept and prior seeding	Gluclub	End April	60	75	Flag Smut.
Smith, C. & Sons	1916 and 1921	3 years Fallow, Wheat, Oats	Salmon and gimlet	June	Disc	3	Good	Disc cultivated July-Aug Springtyne cultivated Sept	Gluclub	End April	45	70	Takeall
Brown, S A	1914	2 years Fallow, Wheat	Salmon and gimlet	June-July	Mouldboard	3	Good	Rigid-tyne scarified Aug., Sept., Sept-Oct, and prior to seeding	Gluclub	3rd week, May	50	87	Takeall.
Farrall, F. C & Sons	1912 and 1921	3 years Fallow, Wheat Oats	Salmon and gimlet	June	Mouldboard	4	Good	Disc cultivated Aug, springtyne cultivated end April and prior to seeding	Gluclub	Mid-May	51	103	Takeall
Strange, P. A	1924	3 years Fallow, Wheat Wheat	Salmon, gimlet, and mallee	June-July	Disc cultivator	3-4	Patchy	Disc cultivated Sept-Oct Springtyne cultivated April and prior to seeding	Caliph	End May	50	96	Takeall and Flag Smut.

All competitors graded seed wheat and treated it with copper carbonate

KUKERIN AGRICULTURAL SOCIETY.

Judge—G. L. THROSSELL, Agricultural Adviser.

The seven competitors in the Kukerin Agricultural Society's Competition were not eligible to compete for the championship award for Zone 7 owing to the lateness of their entry.

The awards were made as follow:—

KUKERIN AGRICULTURAL SOCIETY.

Judge—G. L. Throssell, Agricultural Adviser.

Competitor.	District	Variety.	Yield. 50 pts	Freedom from Weeds. 10 pts.	Freedom from Disease. 10 pts.	Freedom from Admixture. 15 pts.	Evenness of Growth. 15 pts.	Total 100 pts.
English, J. C. ...	Merilup ..	Free Gallipoli	29	9	8	13	12	71
Williams, T. C....	S. Kukerin .	Free Gallipoli	27	8	8	13	14	70
Nenke, B. ...	Kukerin ...	Ford .. .	26	9	8	13	13	69
Bahr, O. ...	S. Kukerin ..	Bena ...	24	9	7	12	14	66
Ditchburn, R. ...	N. Kukerin ..	Free Gallipoli	19	8	8	12	13	60
Adams & English	Merilup ...	Nabawa ...	19	8	7	12	12	58
Sugg Bros. ...	Kukerin ..	Bald Early ..	18	7	7	12	12	56

The rainfalls, as recorded at Kukerin during the year, are as follow:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug	Sep.	Oct.	Total	Nov	Dec.	Total for year.
Kukerin	...	20	46	101	241	197	202	416	368	54	1,478	38	73	1,756

Hereunder are tabulated the cultural details of the competing crops:—

CULTURAL DETAILS

Competitor.	Timber.	No of Crops.	Rotation.	When Plough'd	Implement	Condition of Land.	Depth.	Subsequent Cultivations	Variety.	When Planted.	Rate of Seed.	Rate of Super.	Disease.
English, J. C. ...	Jam and salmon	Since 1916	2 years, Fallow, Wheat	March	Rigid-tyne scarifier	Good	in. 2	Rigidtyne scarified June, skim ploughed Aug., scarified prior to seeding with combined cultivator drill	Free Gallipoli	Mid-May	lbs. 50	lbs. 80	Takeall, Mildew. Loose Smut.
Williams, T. C.	Salmon, jam and morrel	Since 1912	3 years Fallow. Wheat, Oats	June	Mould-board	Good	3–4	Disc cultivated mid-Aug Springtyne cultivated Sept., and prior to seeding with combined cultivator drill	Free Gallipoli	Mid-May	50	80	Takeall.
Nenke, B. ...	Salmon and mallee	Since 1915	4 years Fallow, Wheat, Stubble, Pasture	July	Mould-board	Good	3	Springtyne cultivated mid-Sept., and prior to seeding with a disc	Ford	3rd week May	50	60	Takeall
Bahr, O.	Salmon and manna	Since 1913	2 years Fallow, Wheat	July	Mould-board	Wet	5	Cultivated with combined cultivator drill Oct Planted with a combined cultivator drill	Bena	Mid-May	40	70	Takeall, Rust, Flag Smut
Ditchburn, R.	Salmon, mallee, tea tree	15 years	3 years Fallow. Wheat Stubble	July	Mould-board	Good	4	Springtyne cultivated Aug., twice in Sept., and Oct., and twice prior to seeding with combined cultivator drill	Free Gallipoli	1st week May	70	75	Takeall
Adams & English	Morrel and mallee	3	4 years Fallow, Wheat, Oats Pasture	June-July	Mould-board	Good	3	Springtyne cultivated Sept., and prior to seeding with combined cultivator drill	Nabawa	Mid-May	55	90	Takeall.
Sugg Bros.	Salmon-	Since 1912	4 years Fallow, Wheat, Wheat, Oats	Aug.	Cultivator disc	Boggy	3	Springtyne cultivated early April. Planted with combined cultivator drill	Bald Early	Mid-April	40	80	Takeall.

All seed wheat graded and treated with copper carbonate.

KARLONING PROGRESS ASSOCIATION.

Judge—N. DAVENPORT, Agricultural Adviser.

The 50-acre wheat crop competition, conducted by the Karloning Progress Association, was judged according to the conditions governing the Royal Agricultural Society's competitions, excepting that crops grown on unfallowed land were permitted to compete.

The awards for the eleven crops inspected are as follow:—

KARLONING PRIMARY PRODUCERS' ASSOCIATION.

Judge—N. Davenport, Agricultural Adviser.

Competitor.	Yield. 50 pts.	Freedom from Weeds 10 pts.	Freedom from Disease 10 pts.	Freedom from Admixture. 15 pts	Evenness of Growth. 15 pts.	Total. 100 pts.
Johnston, H.	19	9	9	14	12	63
O'Neil, H.	15	9	9	13	13	59
Driver, H	15	9	8	14	12	58
Tallis, W.	15	9	7	14	13	58
Hewitt, E. E.	15	8	9	13	12	57
Seeby, H.	14	8	8	14	12	56
Broomhall, V.	14	9	7	13	12	55
Hewitt, B. G.	14	7	9	13	12	55
McInnes, P.	13	8	9	13	12	55
Bell, G.	14	8	7	13	12	54
Borlace, J.	10	9	9	14	11	53

The rainfalls, as recorded at Karloning during the year, are as hereunder:—

——	Jan	Feb.	Mar	Apl.	Growing Period. May.	June.	July.	Aug.	Sep.	Oct.	Total.	Nov.	Dec.	Total for year.
Karloning ...	...	...	12	57	350	113	211	115	123	42	954	72	4	1,099

The cultural details of the competing crops are summarised below:—

CULTURAL DETAILS

Competitor.	No. years Cropped.	Timber.	When Ploughed.	Condition of Land.	Implement	Depth.	Subsequent Cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Disease.
						in				lbs.	lbs.	
Johnston, H. ...	New land	Mallee scrub	Aug.	Good	Disc	3–4	Planted with combined cultivator drill	Nabawa	4th week April	30	70	
Driver, H. ...	2	Salmon and gimlet	...	..	..	.	Planted with combined cultivator drill after good stubble burn	Nabawa	2nd week May	30	60	Trace Flying Smut.
Tallis, W. ..	2	Salmon and gimlet	..	..	.	..	Planted with combined cultivator drill on stubble land	Gluyas Early	3rd week April	30	45	Trace Flag Smut.
Hewitt, E. E. ...	3	Salmon, gimlet and mallee	July	Good	Disc	3½	Cross-ploughed with sundercut mid-Aug. Planted with disc drill	Gluyas Early	1st week May	30	40	
Seeby, H. ...	3	Salmon gimlet, mallee and broom bush	July	Good	Disc	3	Planted with combined cultivator drill	Gluyas Early	2nd week May	25	45	
Broomhall, V. ...	2	Gimlet and mallee	..	.	.	..	Planted with combined cultivator drill	Gluyas Early	1st week May	35	60	Flag Smut.
Hewitt, B. G. ...	6	Gimlet, salmon, brown mallee	July	Wet	Disc	3½	Cultivated with spring-tyne cultivator in Oct., harrowed Nov. Planted with combined cultivator drill	Gluyas Early	2nd week May	30	36	
McInnes, P. ...	2	Mallee ...	...	..		.	Planted with combined cultivator drill after stubble burn	Gluyas Early	3rd week May	36	45	
Bell, G. ...	3	Salmon and gimlet	...	.	.		Planted with combined cultivator drill after stubble burn	Gluyas Early	2nd week May	39	60	Flag Smut.

Particulars from H. O'Neil and J. Borlace not to hand. All competitors graded and treated seed wheat with copper carbonate

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Judge—G. L. THROSSELL, Agricultural Adviser.

Nine competitors submitted crops for inspection in the crop competition conducted by the Phillips River Agricultural Society, Ravensthorpe, the awards being made as follow:—

PHILLIPS RIVER AGRICULTURAL SOCIETY- RAVENSTHORPE.

Judge—G. L. Throssell, Agricultural Adviser.

Competitor	District.	Variety.	Yield. 50 pts.	Freedom from Weeds. 10 pts	Freedom from Disease. 10 pts.	Freedom from Admixture. 15 pts.	Evenness of Growth. 15 pts.	Total. 100 pts
McCulloch J	Ravensthorpe	Nabawa	26	9	9	13	13	72
Love, N S	Ravensthorpe	Ford	24	9	8	13	14	68
Smith, W H	Kuliba	Nabawa	24	9	8	13	13	67
Campbell, J	Mt. Short	Gluyas Early	22	9	8	14	14	67
Metz, E	Ravensthorpe	Merredin	22	9	9	13	14	67
Chambers Bros.	Ravensthorpe	Gluyas Early	21	8	8	13	14	65
Barrett Bros	Mt Short	Nabawa	19	9	9	13	14	63
Bebbington Bros	Mt Short	Nabawa	17	9	9	13	14	62
Hambly, L	Ravensthorpe	Nabawa	18	9	8	13	13	61

The following rainfalls were recorded during the year at the centres nearest to the competing crops:—

	Jan	Feb.	Apl	Apl.	Growing Period May.	June	July.	Aug.	Sep	Oct	Total.	Nov	Dec.	Total for year.
Ravensthorpe	8	26	35	136	198	157	163	441	183	45	1,187	105	29	1,521
Mt Short	4	13	25	127	221	134	124	372	175	38	1,064	77	30	1,340
Hopetoun	22	17	56	165	242	258	202	385	303	162	1,552	102	37	1,951

ERRATUM.

EXPERIMENT ON GREEN MANURING.

Unfortunately some of the figures were misplaced in the statement in the experiment in the last issue of the "Journal of Agriculture." The corrected figures are as follow:—

Plots.	Weight of plot in tons.	Weight per acre. tons.	cwts.	Mean of control. tons.	cwts.	Gain or Loss.
Field Peas control	·825	12	9·98	...		— 8·4 cwt.
Peas and Tick Beans	·8091	12	5·18	...		— 13·2 „
Tick Beans ...	·7880	11	19·18	12	18·38	— 19·2 „
Vetches	·7616	11	10·78	...		— 1 ton 7·6 „
Field Peas control	·8804	13	6·78	...		+ 8·4 „

THE COST OF FEEDING PURE-BRED COWS UNDER THE AUSTRALIAN OFFICIAL HERD RECORDING SCHEME, WESTERN AUSTRALIA, 1930-31.

G. K. BARON-HAY and L. C. SNOOK.

Over a period of years an endeavour has been made by the West Australian Department of Agriculture to estimate the cost of the rations fed to the cows in the various pure-bred herds under official test. The Herd Testing Officer, on his monthly visit to each herd, ascertains as accurately as possible the food fed to cows under test, the character of pasture being grazed and fodder crops fed. From these reports the value of the food fed to the stock for the lactation period may be gauged.

The various foodstuffs were valued as under:—

	£	s.	d.	
Chaff - Oaten or Wheaten	3	17	6	per ton.
Clover Hay	2	15	0	,,
Silage	0	7	0	,,
Wheat	0	2	9	per bus.
Oats (Crushed)	0	1	9	,,
Bran	6	0	0	per ton.
Pollard	6	6	0	,,
Linseed Meal	13	10	0	,,
Lucerne Hay	6	0	0	,,
Green Lucerne	1	10	0	,,
,, Maize ... } ,, Sudan Grass } ,, Barley } Chaffed ...	0	6	0	,,
Grazed ...	0	2	6	per head per week.
Pasture	0	1	6	per head per week.
Oilcake	0	12	0	per cwt.

The results obtained for the twelve months beginning July, 1930, illustrate in no uncertain fashion the remarkable fall in the cost of feeding cows under test, due in most instances to better methods of managment enabling the bulk of the fodder to be produced on the farm.

TABLE 1.

Year.	Average Cost of Feed per Cow for nine months.	Cost of Feed to produce 1 gallon Milk.	Cost of Feed to produce 1 lb. Fat.
	£ s. d.	d.	d.
Average—1924–30	14 3 8	5·54	11·42
1929–30	14 10 3	5·10	12·74
1930–31	9 14 7	3·63	7·74

This fall in the cost of feeding a cow under test has more than compensated for the drop in prices received for dairy produce, and demonstrates one rapid method by which dairy farmers can meet and, in many instances, are meeting the present fall in value of butter fat.

TABLE 2.

Comparison of Fall in Value of Butter Fat with Cost of Feeding.

Year.	Average Monthly Price of Butter Fat per lb.	Per cent. fall in Price.	Average Cost of Feed to produce 1 lb. of Butter Fat.	Per cent. decrease in Cost of Feeding.
	s. d.	%	d.	%
1924–30	1 7·1	...	11·42	...
1931	1 3	20·9	7·74	32·2

This fortunate circumstance is in a large measure due to the increased use of home-grown materials. It is no coincidence that all the herds which stand out as cheap producers of milk and butter-fat use meadow hay (or its equivalent) and silage, with crushed oats (generally home grown) as the grain supplement.

TABLE 3.

The Value of Home-Grown Fodders.

——	"A." With Silage. 6 Herds.	"B." No Silage. 10 Herds.	Per cent. in favour of Herds having Silage.
	d.	d.	%
Per 1lb. Butter Fat	6·04	9·18	52
Per 1 gallon Milk	3·00	4·36	45·3

The farmer who maintains good pastures by adequate fertilisation and wise management, who conserves ample meadow hay and has silage as the succulent base for his summer ration, and who grows his own concentrates in the form of oats and peas, has no need to purchase foodstuffs for his stock. This is well illustrated by the three herds which had the lowest feed costs per cow in the year under review.

Herd "M," owned by Messrs. Giblett and Johnston, produced both milk and fat at a very low cost, but as they had a very small herd (average 4⅓ cows for year) which was not fed to give high production, the significance of their results must be somewhat discounted. Practically no foodstuffs were purchased for this herd, entire dependence being placed on the natural pastures, hay and silage, the latter being of only medium quality. The yields fell off greatly during the summer, and it is certain that more expensive feeding during this period, in order to enable the cows to produce to their capacity, would have been profitable. The returns show what can be done in the absence of any concentrates whatsoever. The yields of these cows also would have been higher had the silage available been of good quality.

Herd "F," owned by Mr. P. Rose, is the largest herd under test, and the low cost of feeding combined with the high average return of butter-fat (322.7 lbs.) testifies to sound and economical feeding practice. Very little foodstuff is purchased. Mr. Rose has extensive pastures of clovers and mixed grasses, but has no summer land. Hence reliance is placed on ample meadow hay and the

use of stack silage. Crushed oats are used as the grain supplement, while chaffed maize is used in the early summer. Most of the cows are timed to calve in order that they may end their lactation period about January, so as to be resting during that portion of the year most inimical to cheap milk production. Oats and peas are grown extensively as forage and grain crops. (See Tables 6 and 7.)

Herd "J," at the Denmark Stud Farm, is also a large herd with a good average production (290 lbs.) of butter-fat. The need for purchased foods is here again avoided by good pasture management, and the use of meadow hay, silage, and crushed oats. As one would expect, considerable amounts of chaffed greenstuff were fed to the stock during the year.

These three herds indicate the aim in dairy practice—independence of purchased foods.

Another circumstance well worthy of note is the great difference in profit resulting to the farmer, according as to whether he sells whole-milk or butter-fat. (See Table 9.) The vendor of whole-milk receives approximately double the profit than does the less fortunate farmer selling the equivalent as butter-fat. For example, if the produce of the 15 cows in the Denmark Guernsey herd (essentially butter-fat producers) was sold as whole-milk instead of as butter-fat, the resultant extra profit would amount to over £130 in a year. With Mr. W. G. Burges' herd of 16 Australian Illawarra Shorthorns, the difference is approximately £300 in favour of selling whole-milk. These figures are based on the values—whole-milk at 1s. 1d. per gallon and butter-fat at 1s 4d. per lb., with allowance for skim milk being worth 1d. per gallon. The figures indicate why suppliers of whole-milk situated near the metropolitan area can maintain herds despite the high cost of feeding with purchased fodders.

As in previous years, the various breeds have been compared as regards cost of feeding and average yields. (See Table 4.) Very little significance can be attached to these figures, however, as an argument supporting any one breed. One expects the Shorthorn breed to excel as whole-milk producers and to consume more fodder per head than either of the other two breeds recorded, but this is in part compensated for by the larger calf. The relative positions of the Jersey and Guernsey change from year to year, first one breed and then the other appearing to be the cheaper producers of butter-fat.

TABLE 4.

Breed.	Average Yield of Butter Fat.	Average Yield of Milk.	Average Cost of Feed.
	lb.	gals.	£ s. d.
Jersey (7 herds)	321·8	617·1	9 8 2
Guernsey (4 herds)	312·4	608·1	8 19 11
Australian Illawarra Shorthorn (5 herds)	275·8	689·3	10 8 4

Following is a series of tables showing:—

5. Herds in Order of Merit as Producers of Butter-fat.
6. Herds in Order of Merit as Producers of Milk.
7. Herds in Order of Merit showing Cost of Producing 1lb. of Butter-fat.

8. Herds in Order of Merit showing Cost of Producing 1 gallon of Milk.
9. Average for Eight-Year Period.
10. Average for Year 1930-31.

TABLE 5

HERDS IN ORDER OF MERIT AS PRODUCERS OF BUTTER FAT.

Herd.	Breed.	Average Production of Butter Fat per cow for 9 months	Average Production of Skim Milk per cow for 9 months	Value of Butter Fat at 1s. 4d lb	Value of Skim Milk at 1d gal	Gross return for Fat and Skim Milk	Cost of Feed per cow for 9 months.	Profit per cow by sale of Butter Fat	Cost of Feed to produce 100lbs. Butter Fat	Cost of Feed to produce 1lb. Butter Fat.
		lbs.	gals	£ s. d.	£ s. d	£ s d	£ s. d.	£ s. d.	£ s. d.	pence
A	Jersey	408 76	680·7	27 5 0	2 16 10	31 1 10	11 10 0	19 11 10	2 16 4	6·77
B	Guernsey	383 55	633·88	25 11 5	2 12 10	28 4 3	12 15 0	15 9 3	3 6 6	7 98
C	Australian Illawarra Shorthorn ..	365 00	774 7	24 6 8	3 4 7	27 11 3	9 3 1	18 8 2	2 10 0	6·00
D	Jersey	353 55	527·6	23 11 5	2 3 11	25 15 4	9 9 0	16 6 4	2 13 3	6·38
E	Australian Illawarra Shorthorn ...	350·00	794 5	23 6 8	3 6 2	26 12 10	11 16 1	14 16 9	3 7 3	8·06
F	Jersey	322 70	600·93	21 10 3	2 10 10	24 1 1	6 7 10	17 13 3	1 19 8	4·75
G	Jersey	317·00	539 9	21 2 8	2 4 2	23 6 10	10 19 0	12 7 10	3 9 1	8·28
H	Guernsey	310·29	533 8	20 13 8	2 4 6	22 18 2	10 7 5	12 10 9	3 4 3	7 70
I	Jersey	300·49	487 6	20 0 8	2 0 8	22 1 4	13 3 0	8 18 4	4 7 3	10 46
J	Guernsey	290·00	500·5	19 6 8	2 1 8	21 8 4	7 7 4	14 1 0	2 10 10	6 10
K	Jersey	270·90	493·1	18 1 3	2 1 1	20 2 4	10 19 7	9 2 9	4 1 2	9·74
L	Jersey	264·6	431·4	17 12 8	1 15 11	19 8 7	11 8 2	8 0 5	4 6 2	10·32
M	Guernsey	260 9	529·7	17 7 10	2 4 2	19 12 0	3 19 10	15 12 2	1 10 9	3·69
N	Australian Illawarra Shorthorn ...	260 07	632 3	17 6 9	2 12 6	19 19 3	11 8 0	8 11 3	4 7 9	10·53
O	Australian Illawarra Shorthorn .	237 4	553·8	15 16 5	2 6 2	18 2 7	10 1 2	8 1 5	4 4 9	10·17
P	Australian Illawarra Shorthorn ...	229 98	503·6	15 6 8	2 1 11	17 8 7	10 11 7	6 17 0	4 12 0	11·04
	Average	301 6	579 0	20 2 2	2 8 3	22 10 5	9 14 7	12 15 10	3 4 6	7·74

TABLE 6

HERDS IN ORDER OF MERIT AS PRODUCERS OF MILK

Herd.	Average Yield of Milk per Cow for 9 months.	Value of Milk at 1s. 1d gal.	Cost of Feed per Cow for 9 months.	Profit on Sale as Whole Milk.	Cost of Feed to produce 1 gal of Milk.	Breed
	gals.	£ s d.	£ s. d.	£ s d.	pence	
E . . .	882 8	47 16 4	11 16 1	36 0 3	3 20	Australian Illawarra Shorthorn.
C	860·8	46 12 6	9 3 1	37 9 5	2 55	Australian Illawarra Shorthorn.
A	767·5	41 11 9	11 10 0	30 1 9	3 59	Jersey
B	737·6	39 19 2	12 15 0	27 4 2	4·14	Guernsey.
N .	702·6	38 1 2	11 8 0	26 13 2	3 89	Australian Illawarra Shorthorn
F	667 7	36 3 4	6 7 10	29 15 6	2 30	Jersey
O . .	615 4	33 6 8	10 1 2	23 5 6	3 92	Australian Illawarra Shorthorn.
G ..	599 9	32 10 0	10 19 0	21 11 0	4 38	Jersey
H	593 1	32 2 6	10 7 5	21 15 1	4 20	Guernsey.
M	588 4	31 17 5	3 19 10	27 17 5	1 63	Guernsey
D .	586 2	31 15 0	9 9 0	22 6 0	3 87	Jersey
P ..	559 6	30 6 3	10 11 7	19 4 8	4 54	Australian Illawarra Shorthorn.
J	556 1	30 2 5	7 7 4	22 15 1	3 18	Guernsey
K . . .	547 9	29 13 6	10 19 7	18 13 11	4 93	Jersey.
I ...	541·8	29 6 11	13 3 0	16 3 11	5 83	Jersey
L .. .	479 3	25 9 3	11 8 2	14 1 1	5 71	Jersey
Average .	643 3	34 16 11	9 14 7	25 2 4	3 63	

TABLE 7.

HERDS IN ORDER OF MERIT SHOWING COST OF FEED PER POUND OF BUTTER FAT PRODUCED.

Herd.	Cost of Feed per 1lb. of Fat.	Under Average.	Over Average.	Breed.
	pence.	pence.	pence.	
M	3 69	4·05	...	Guernsey.
F	4 75	2·99	...	Jersey.
C	6 00	1·44	...	Australian Illawarra Shorthorn.
J	6 10	1·34	...	Guernsey.
D	6·38	1·06	...	Jersey.
A	6·77	0·67	...	Jersey.
H	7·70	0·04	...	Guernsey.
B	7 98	...	0·24	Guernsey.
E	8·06	...	0·32	Australian Illawarra Shorthorn.
G	8·28	...	0 54	Jersey.
K	9·74	...	2 00	Jersey.
O	10 17	...	2·43	Australian Illawarra Shorthorn.
L	10·32	..	2·58	Jersey.
I	10·46	...	2·72	Jersey.
N	10·53	...	2·79	Australian Illawarra Shorthorn.
P	11·04	...	3·30	Australian Illawarra Shorthorn.
Average	7·74	...	...	...

TABLE 8.

HERDS IN ORDER OF MERIT SHOWING COST OF FEED TO PRODUCE ONE GALLON OF MILK

Herd.	Breed.	Cost of Food to produce 1 gal. Milk.	Below Average Cost.	Over Average Cost.
		pence.	pence.	pence.
M	Guernsey	1·63	2·00	...
F	Jersey	2·30	1·33	.
C	Australian Illawarra Shorthorn	2·55	1·08	
J	Guernsey	3·18	0·45	..
E	Australian Illawarra Shorthorn	3·20	0·43	.
A	Jersey	3·59	0·04	.
D	Jersey	3·87	.	0·24
N	Australian Illawarra Shorthorn	3·89		0·26
O	Australian Illawarra Shorthorn	3·92	..	0·29
B	Guernsey	4·14		0·51
H	Guernsey	4·20	..	0·57
G	Jersey	4·38	.	0·75
P	Australian Illawarra Shorthorn	4·53		0·90
K	Jersey	4·93		1·30
L	Jersey	5·71		2·08
I	Jersey	5·83		2·20
Average		3·63		

TABLE 9.—HERD AVERAGES FOR EIGHT YEARS, 1924–1931

Year	Milk	Average Fat per Cow for period of 9 months	Average Skim Milk per Cow for period	Value of Fat for period	Value of Skim Milk for period at 2d. per gallon	Average Value of Fat and Skim Milk for period	Cost of Feed per Cow for period	Net Profit per Cow for period through Sale of Fat.	Value of whole Milk at 1/3 per gallon allowing for rearing Calf	Net Profit per Cow through Sale of Fresh Milk at 1/3 per gallon.	Average Cost to produce 1lb Fat.	Average Cost to produce 1 gall. Milk.
	gallons.	lbs.	lbs	£ s d	£ s d	£ s d.	£ s d	£ s d.	£ s. d.	£ s. d.	pence	pence.
1924 ..	600	319 50	362	At 1/7½ per lb 25 19 2	3 0 4	28 19 6	10 4 10	18 4 8	32 1 3	21 16 5	7 7	4 09
1925 ...	652	308 59	407	At 1/5¼ per lb 22 10 0	3 7 10	25 17 10	14 13 2	11 4 8	30 10 5	15 9 5	10·77	6·15
1926 ...	624	312·01	393	At 1/7 per lb 24 14 0	3 5 6	27 19 6	14 14 7	13 4 11	32 5 5	17 10 10	11·15	5·66
1927 ..	602	290·72	362	At 1/7 per lb. 23 0 4	3 0 4	26 0 8	14 10 5	12 6 8	31 10 6	17 0 1	12·00	5 79
1928 .	592	280 56	353	At 1/7½ per lb. 22 15 9	2 18 10	25 14 7	15 11 4	10 3 3	30 19 0	15 7 8	13 34	6·34
1929 ...	629	295 10	386	At 1/8 per lb. 24 11 10	3 4 4	27 16 2	15 1 0	12 15 2	33 6 9	18 5 9	12·24	5·74
1930 ...	636	294·98	369	At 1/7½ per lb. 23 19 6	3 5 4	27 4 10	14 10 3	12 14 7	30 3 3	15 13 0	12·74	5·10
1931 ...	643	306 1	399	At 1/4 per lb. 20 2 2	At 1d. gal 1 13 3	21 15 5	9 14 7	12 0 10	At 1/1 gal. 25 10 1	At 1/1 gal. 15 15 6	7·74	3 63
Average of 8 years	622	300 94	379	At 1/6¾ per lb 23 11 6	2 19 6	26 11 0	13 12 6	12 18 6	30 15 10	17 3 4	10·96	5·31

During the year 1930-31 the average cow under test produced in nine months:—

TABLE 10.

1. 643 gallons of Milk.
2. 301·6 lbs. of Butter Fat.

	£	s.	d.
Value of Butter Fat at 1s. 4d. per lb.	20	2	2
Value of Skim Milk at 1d. per gallon	2	8	3
Total Return by Sale of Butter Fat ...	22	10	5
Cost of Feed for Period	9	14	7
	£12	15	10
Value of Whole Milk at 1s. 1d. per gallon ...	34	16	11
Cost of Feed	9	14	7
Profit by Sale of Whole Milk	£25	2	4

Cost of Feed to produce 1 gallon of Milk ... 3 63d.
Cost of Feed to produce 1 lb. of Butter Fat .. 7 74d

OAT VARIETY TRIALS, DENMARK, 1931.

G. GAUNTLETT, Agricultural Adviser, Dairy Branch.

The Oat Variety Trials conducted in the Denmark district were continued during 1931.

This experiment was conducted on the property of C. Crellin, with the following results:—

Soil: Red karri loam. During 1930 potatoes were grown.

Cultivation: Ploughed first week in June. The seed and fertiliser were broadcast and harrowed in on 12th June.

Rate of Seeding: 2 bushels per acre.

Fertiliser: Superphosphate, 120 lb. per acre.

Rainfall during growing period: 32 inches.

The yields obtained were as follow:—

GREEN MATERIAL.

Variety.	Yield—(Average of 3 plots.)				Percentage Yields
	tons.	cwts.	qrs.	lbs.	
Algerian	5	0	3	18	100
Guyra	5	0	3	9	99·9
Mulga	4	6	1	21	87·4
Burt's Early	2	15	3	7	55·5
Lachlan...	2	14	0	1	53·5

Very little difference could be seen between the plots until several months after germination. At the time of cutting, the "Algerian" and "Guyra" were not so mature as the other varieties and yet they returned far greater bulk.

As has invariably proved the case in these experiments, "Algerian" has proved itself to be one of the best varieties. The failure of "Lachlan" is somewhat surprising. In last year's trials at the Denmark State Farm, "Lachlan" returned the heaviest yield of hay per acre. Too great an importance should not be attached to results from any one year. Experiments must be conducted over a period of three to five years before definite conclusions may be accurately drawn. In this connection it is of interest to study the tabulated results of all the variety trials conducted in the Denmark area by the Department of Agriculture.

Algerian.	Variety.				Place conducted.	Year.
	Lachlan.	Guyra.	Mulga.	Burt's Early.		
tons. cwt.	tons cwt.	tons cwt.	tons cwt.	tons cwt.		
...	4 6	3 12	...	2 18	Group 41	1929
...	5 8	3 12	...	4 8	Group 41	1929
...	3 10	3 1	...	3 1	Group 105 ...	1929
2 15	2 7	2 12	2 8	2 6	Group 41	1930
9 8	10 14	9 2	...	...	Denmark S.F. ...	1930
5 1	2 14	5 1	4 6	2 16	Scotsdale	1931
Av. 5 15	4 17	4 10	3 7	3 2		

The following is a summary of Oat Variety Trials carried out in the Denmark district:—

OAT VARIETIES—DENMARK DISTRICT.

Purpose for which grown.	Time of Sowing.	Varieties recommended.
Early Autumn Fodder	February–March	Burt's Early Mulga
Spring Green Fodder	July–September	Lachlan Guyra
Main Crop for Hay	May–June	Algerian Guyra Lachlan

Cultivation, etc.

For early feed, the land should be well worked to a fine tilth and a firm seed bed. For other purposes it is not necessary to work the land to a fine tilth.

Seed should be sown at not less than 2 bushels per acre, and superphosphate applied at the rate of 1½ to 2 cwts. per acre.

Experiments also have shown that "Burt's Early" is preferable to barley for early autumn feed.

FRUIT EXPORT FOR 1932.

GEO. W. WICKENS, Superintendent of Horticulture.

The export season for fresh and dried fruits will be in full swing when the Journal containing these notes is published, but particulars of boats and quantities as shown hereunder will be of interest to readers. Until late in February grave doubts were felt regarding shipping as there seemed a big possibility that the space offering would be insufficient to lift the quantity of fresh fruit available for export, but owing to the united efforts of various bodies—particularly the Fruit Shippers' Committee—difficulties were overcome and a very good programme was arranged. Space has been ordered for a total of 661,240 cases, and to lift this quantity nine boats are calling at Albany and 25 at Fremantle, and the shipping season will extend from 13th February to 23rd May.

Details referred to are as follow:—

Date of Sailing. 1932.		Vessel.	Quantity.	Port.
Feb.	13th	"Jervis Bay"	6,000 cases	Fremantle.
,,	28th	"Surrey"	14,000 ,,	,,
Mch.	7th	"Orontes"	2,300 ,,	,,
,,	9th	"Bitterfeld"	20,000 ,,	Albany.
,,	10th	"Barrabool"	30,750 ,,	Fremantle.
,,	11th	"Port Nicholson"	135,200 ,,	Albany 70,900 Fremantle 64,300
,,	14th	"Mooltan"	5,100 ,,	Fremantle.
,,	14/19th	"Turakina"	41,900 ,,	,,
,,	17th	"Port Sydney"	46,400 ,,	Fremantle 11,200 Albany 35,200.
,,	18th	"Larg's Bay"	23,000 ,,	Fremantle.
,,	21st	"Strathnaver"	720 ,,	,,
,,	24th	"Nestor"	5,250 ,,	,,
,,	28th	"Orsova"	1,000 ,,	,,
,,	30th	"Port Hardy"	49,000 ,,	Albany.
April	1st	"Ceramic"	11,000 ,,	Fremantle.
,,	4th	"Maloja"	5,000 ,,	,,
,,	5th or 6th	"Limerick"	7,000 ,,	Albany.
,,	8th	"Moreton Bay"	23,000 ,,	Fremantle.
,,	11th	"Orford"	2,000 ,,	,,
,,	13th	"Corrientes"	50,000 ,,	Albany.
,,	14th	"Balranald"	10,000 ,,	Fremantle.
,,	18th	"Strathaird"	720 ,,	,,
,,	20th	"Strassfurt"	25,000 ,,	Albany
,,	22nd	"Esperance Bay"	23,000 ,,	Fremantle.
,,	25th	"Orama"	2,300 ,,	,,
,,	27th	"Canonesa"	50,000 ,,	Albany.
May	2nd	"Comorin"	2,500 ,,	Fremantle.
,,	9th	"Ormonde"	1,000 ,,	,,
,,	10th	"Ulysses"	5,250 ,,	,,
,,	12th	"Bendigo"	18,350 ,,	Albany.
,,	20th	"Hobson's Bay"	23,000 ,,	Fremantle.
,,	23rd	"Baradine"	21,500 ,,	,,
		Total	661,240 ,,	

At time of writing, 1st March, only two small lines of those mentioned above have gone forward, but I am pleased to note that both apples and pears have, in the main, been of good quality and well packed, and I am taking this as a favourable augury for a successful season.

So many unfavourable comments have been made recently concerning the condition of Australian fruit upon arrival in England that it behoves all growers to select carefully, reject rigorously, grade evenly, both in size and colour, and pack

correctly, so that the good name which Western Australian fruit has won on the overseas markets may be retained.

Amendments to the regulations governing the export of fresh fruit have recently come into force, and as printed copies of these are not yet available I quote hereunder extracts that concern rather materially shippers in this State. The first deals with the collection of three-eighths of a penny on every case offered for shipment, and reads as follows:—

104. (1) There shall be paid to the Collector of Public Moneys of the Department of Markets in the States of Victoria, New South Wales, and Queensland, and the Collector of Customs in the States of South Australia, Western Australia, and Tasmania, an inspection fee of three-eighths of one penny in respect of each case of apples and pears intended for export.

(2) Any such apples or pears shall not be permitted to be removed for home consumption from any appointed place, nor shall an export permit be issued therefor, until the fees in respect of the apples or pears have been paid.

(3) For the purposes of this regulation two half cases or three trays shall be regarded as the equivalent of one case.

Although this is described as an inspection fee it is really being collected by the Commonwealth Government at the request of growers and shippers, and is to be used mainly in advertising Australian fruit in the overseas markets.

The second item quoted refers to the cases which may be used for exporting fruit. The original regulations specified only the cases which could be used for apples, pears, and oranges, but the amended regulations prescribe cases for apples, pears, citrus fruits, grapes and stone fruits. Shippers will note that the three-quarter bushel flat is now a grape case only, and cannot be used for pears or stone fruits as in the past. Also that the dump case can no longer be used when shipping fruit to England, Canada and the Far East—Singapore, Java, etc. The case prescribed for this purpose being the package having dimensions 24in. x 11½in. x 11½in. in use in other parts of the world. Particulars are as under:—

Regulation 47 of the Commerce (General Exports) Regulations is repealed and the following regulation inserted in its stead:—

PACKING OF FRESH FRUITS.

47. Fresh fruit intended for export shall be packed in accordance with the following provisions:—

(a) Subject to paragraph (d) of this regulation, the fruit shall be packed only in cases or trays of the following dimensions specified for the various kinds of fruit:—

Descriptions of Case or Tray.	Inside measurements in inches (clear of divisions).					Kinds of fruits for which case or tray shall be used.
	Length.		Depth.		Width.	
Citrus	24	x	11½	x	11½	Citrus fruit only.
Citrus bushel	20	x	10	x	11½	,, ,,
Australian bushel	18	x	14¼	x	8⅔	Apples, pears, citrus.
Standard bushel	18	x	10½	x	11½	,, ,, ,,
Australian half bushel	18	x	7⅛	x	8⅔	Apples, pears, stone fruit.
Standard half bushel	18	x	5¼	x	11½	Apples, stone fruits.
Flat bushel	26	x	14¼	x	6	Pears.
Pears	18	x	8	x	11½	,,
Flat three-quarter bushel ...	24	x	11¾	x	6	Grapes only.
Flat half bushel	26	x	7⅛	x	6	Stone fruit only.
Tray	18	x	Any depth	x	14¼	Apples, pears, grapes, stone fruits.
Tray	18	x	Any depth	x	11½	Apples, pears, grapes, stone fruits.

Provided that those dimensions may show a variation to the extent of not more than 10 per centum (that is, 5 per centum under or 5 per centum above) on the total cubic capacity of the case or tray.

(b) Only one layer of apples shall be packed in each tray.

(c) The fruit shall be packed in clean new cases or trays constructed of well-seasoned soft-wood or hard-wood that has been smoothly sawn or dressed in an approved manner, and in the opinion of the Collector sufficiently strong to withstand such handling as is ordinarily incidental to transport to destinations beyond the Commonwealth.

(d) Citrus fruits intended for export to any port in Great Britain or Canada or to any Eastern port shall be packed only in the type of case described as "citrus" in paragraph (a) of this regulation.

Dried vine fruit was exported from Western Australia earlier this season than for many years past, the "Jervis Bay" taking 37 tons on the 13th February.

NORTH DRAKESBROOK—EXPERIMENTAL PLOTS.

C. GILES, Dairy Instructor.

At the request of the North Drakesbrook branch of the Primary Producers' Association, and following a series of experiments designed three years ago to demonstrate economical methods of establishing pastures on the wet sandy loams overlying clay at various depths (up to 24 inches) general in that district, the following methods were employed:—

Ploughed *v.* Unploughed land and seeded with the following mixture in May, 1928:

Subterranean Clover	4 lb. per acre.
White Dutch Clover	1 lb. "
Paspalum Dilatatum	5 lb. "
Cocksfoot	5 lb. "
Lotus major	1 lb. "
Total	17 lb. "

The areas were top-dressed with superphosphate at the rate of 2 cwt. per acre.

Results had shown that Subterranean Clover in the early stages on this land was outstanding. Indications, however, were that Lotus major, White Dutch Clover, and Perennial Rye Grass will all have a place in pasture mixture sown some years later when soil fertility has increased.

By request of that Association further trials were made this year to discover the possibilities with regard to further improvement over the same area by the introduction of blade grasses. Wimmera Rye Grass, Perennial Rye Grass, and Cocksfoot were selected as being likely, and these were seeded on 25th May, 1931, at the following rates:—

Wimmera Rye Grass	10 lb.
Perennial Rye Grass	8 "
Cocksfoot	2 "
Total	20 "

over the whole area, 1½ acres.

Plots $\frac{1}{8}$ acre each in triplicate were fertilised as follows:—

No. 1 Super. 150 lb. + Sulphate of Ammonia 28 lb. per acre.

No. 2 Super. 150 lb. + Sulphate of Ammonia 56 lb. per acre.

No. 3 Super. 2 cwt. + Sulphate of Ammonia 56 lb. per acre.

The variation in Superphosphate was made in order to compare its influence with the lighter application.

Preparation of Seed Bed.

Arrangements had been made to seed up on 21st May, but on inspection it was found that owing to an exceedingly heavy growth of clover the previous season, and total lack of grazing, it was impossible to seed up with any hope of success, without first removing this bulk.

This surplus growth was therefore removed by hand labour, and the ground then disc-harrowed ready for planting on 25th May.

Method of Seeding.

Seed and fertilisers were mixed and broadcasted immediately by hand and lightly harrowed in.

Inspections.

Inspections were made and conditions noted as follows:—

July 7th.—Germination good; growth satisfactory.

Aug. 11th.—Germination good; growth satisfactory.

Sept. 8th.—Cocksfoot not to be found; badly water-logged.

Oct. 2nd.—Excellent growth of Rye Grasses requiring to be fed off, but too wet for stock to graze.

Oct. 26th.—Inspection arranged with members of the Association prior to grazing, and cows were turned in on the same day.

Results.

Inspection showed that Clovers and Rye Grasses were good right through, subterranean clover predominating:—

Plots No. 1.—Grasses slightly less.

Plots No. 2.—Clovers slightly less than No. 1.

Plots No. 3.—Apparently more bulk; both grasses and clovers excellent. Cocksfoot could not be located anywhere.

Summary.

1. It is evident that Rye Grasses can be easily and successfully established on this class of country after having been down to subterranean clover for at least two years.

2. That drainage, however, is absolutely essential in order that pastures may be grazed throughout the winter when these grasses are most profitable; and unless controlled by this means, little benefit is derived from their inclusion.

3. That heavier applications of phosphates up to 200 lbs. per acre in conjunction with nitrogenous fertilisers are beneficial on mixed pastures and on this type of soil.

A NEW NOXIOUS WEED.

THE DEVIL'S CLAW

Martynia (Proboscidea) Louisiana, Mill.

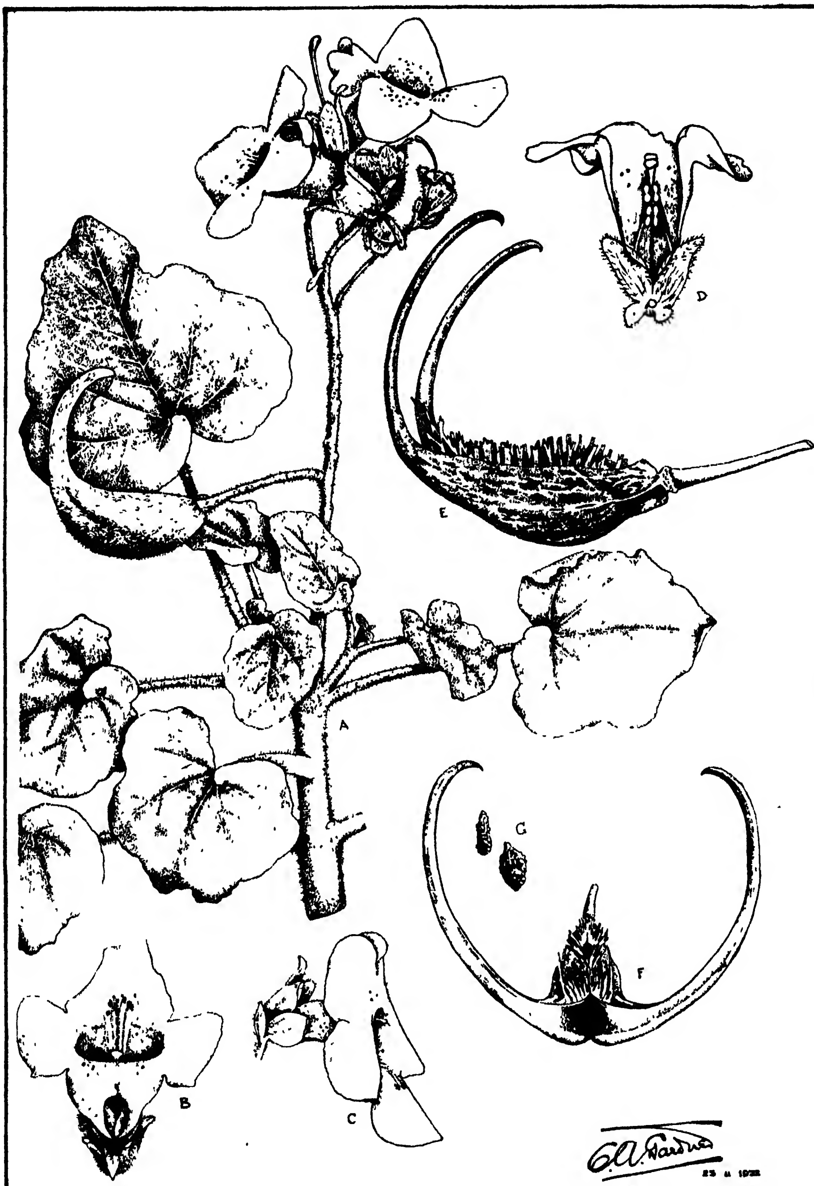
C. A. GARDNER, Government Botanist.

This annual plant, which is at once both formidable and admirably constructed in its fruits for successfully grappling with the legs and feet of stock, obtaining a penetrating hold and thus effectively dispersing its seeds, has appeared in Western Australia. Wherever it has become established it has proved a serious pest to stock owners, inflicting injury on stock and occasionally causing death while spreading itself effectively through the country.

The Devil's Claw is native to the Mississippi districts of the United States of America. It is now fairly common in various parts of America, but does not appear to be as troublesome there as in the countries into which it has been introduced. The plant was first recorded in New South Wales in 1905, since when it has obtained a hold in many districts, even in the drier western parts of the State. Later it was reported from Queensland, then from Victoria, and still more recently from South Australia. In each State it has proved a menace to stock owners, especially to sheep breeders, since it clings more easily to wool than to hair. In the western districts of New South Wales it is regarded as a most serious pest, and it is claimed that sheep have died of starvation through having their mouths closed by the grappling devices of the fruits.

The fruit would appear to have been specially designed to inflict pain. The two main claws are provided with strong sharp points which curve backwards and inwards, and in addition are of the springy nature and texture of strong whalebone, so that any pressure serves but to increase the grip and deepen the penetration. Sheep feeding close to the ground have collected the fruits on their noses. The teeth-like spines of the top of the fruit are caught under the lower jaw, and the long claws grip the face, or may even penetrate into the eye sockets. Any pressure exerted by opening the mouth drives the long claws more deeply in, and extraction being impossible the fruit ultimately firmly grips the jaws, preventing their opening. Sheep are thus known to have died from starvation. In addition, the fruit easily adheres to clothing, wool, legs of animals, etc., and if there is a chance for the claws to penetrate, the anchoring teeth of the pod itself aid this pentration of the claws if any pressure is applied. It is through attaching themselves to the legs of stock and the wool of sheep that the seeds are distributed. Each pod contains about 12 to 15 seeds, most of which are freely liberated when the fruit is ripe, but some remain in lateral cavities towards the back of the fruit, and these are only freed when the fruit disintregrates.

The plant was first recorded officially for Western Australia in February of this year, when specimens were received at the State Herbarium from Cottesloe, stated to have appeared in a vegetable garden following an application of blood and bone fertiliser from Wyndham. This would imply that the species is growing in the East Kimberley district, but confirmation of this has yet to be obtained. The one plant which appeared has been destroyed, and the species proclaimed a noxious weed for the State of Western Australia. It is hoped that by this prompt recognition and proclamation as a noxious weed, it will be immediately arrested should it appear in other parts of the State. The accompanying plate gives all the details necessary for recognition of both the plant and its fruit. It has a rather characteristic aromatic scent reminiscent of Pelargonium.



THE DEVIL'S CLAW.

(*Martynia Louisiana*, Mill.)

EXPLANATION OF PLATE

A, Branch of plant showing leaves, inflorescence and slightly immature fruit. B, View of flower from above. C. Lateral view of flower showing calyx and bracteoles. D, Section of flower showing the four stamens and the style with its two flattened stigmatic lobes. E, Lateral view of fruit from which the fleshy pericarp has fallen. F, Anterior view of the carpels showing the orifice through which the seeds are liberated, and the spread of the horn-like "claws." G, Seeds.

All (except the seeds) about half natural size. *Icon. origin.*

Description of the Plant.

An annual summer-growing herb of somewhat procumbent habit, the branches opposite and divaricate, covered with viscid spreading hairs. Leaves opposite, on rather long and stout leaf-stalks, the blade broad-ovate or orbicular and somewhat cordate, the margins entire, undulate.

Flowers pedicellate in terminal racemes. Bracteoles close under the calyx, oblong or elliptical, deciduous. Calyx more or less inflated, with five rounded unequal lobes, and slit to the base on the lower side, hairy and fringed on the margins with rather long hairs. Corolla pale lilac to yellowish, suffused with rose-pink, large, with a broad expanded tube and expanded limb with obtuse lobes, the two upper lobes smaller than the three lower, elegantly spotted with purple in the throat and tube, and conspicuous by reason of four figures resembling anthers and filaments on the middle lobe of the lower lip. Stamens (4) well included in the tube, in pairs, with a small staminode. Ovary superior, spuriously 2-celled by reason of two intruding parietal placentas bearing numerous ovules; style long and slender with 2 small flat stigmatic lobes. Fruit an oblong capsule with a long curved beak, provided with a somewhat fleshy pericarp which falls as the two carpels separate, the beak splitting into two long curved hook- or horn-like appendages when dry, the upper margin of each carpel fringed with a crest of unequal and variously divided bristle-like processes. Seeds large, somewhat like those of the thorn-apple, black and rugose, irregularly angled or flattened.

TAKE-ALL AND SIMILAR DISEASES OF WHEAT AND HOW TO CONTROL THEM.*

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

The "root-rotting" diseases of wheat known in this State as "Take-all," "Root-rot," and "Foot-rot," and which are caused by the fungi known scientifically as *Ophiobolus graminis*, *Wojnowicia graminis*, and *Helminthosporium sativum*, respectively, have of recent years become the most serious parasitic diseases in wheat crops in this State.

There are several reasons for this. Firstly, there is unfortunately no easy way known of preventing these diseases, as, for example, by the "dry pickling" of the seed with copper carbonate before sowing, as has been found very effective for the control of "bunt" or "covered smut": nor, secondly, are resistant varieties known which can be used to combat them, as is the case with "flag smut," where such varieties as "Geeralying," "Nabawa," "Baroota Wonder," "Beneubbin," "Carrabin," "S.H.J.," etc. (see Leaflet No. 326, or this Journal pp. 214-17, June, 1931) can be used to follow a heavily-infected crop in this State with every certainty of the new crop being almost, if not entirely, free from the disease. Moreover, thirdly, the three-year rotation system, fallow, wheat, pasture, which is a firmly-established practice in many parts of the wheat belt, tends to increase these diseases in succeeding wheat crops, rather than to suppress them, for reasons which will become more obvious later on. Finally, there is a disinclination on the part of many farmers to take these diseases seriously enough in the early stages, with a consequent failure on

* This article represents the subject matter of a lecture given before the Merredin Agricultural Society by the writer on Saturday, 6th February, 1931

their part to employ systematic methods of control. This causes a very rapid increase in the size of the areas affected by the fungi in seasons favourable to their spread.

"Root-rotting" diseases of wheat, due to various fungi, are not in any way peculiar to Western Australia. They occur to a greater or less extent in all the Australian States, and in many other wheat-growing countries, on farms where proper cultural methods are not taken to keep them in subjection.

Microscopic examination in a scientific laboratory is necessary to distinguish properly between the various fungi responsible for "root-rotting" troubles of wheat in this State, but, fortunately, from a practical point of view they may all be considered the same, as the control measures are identical for them all.

"TAKE-ALL" AND "ROOT ROT."

"Take-all" and "Root-rot," due to the fungi *Ophiobolus graminis* and *Wojnowicia graminis*, respectively, in addition to affecting wheat in patches, which may be more or less circular in outline, also attack wheat in strips, or even individual plants scattered irregularly through the crop. Both cause a very decided, and often shiny, black discolouration or "stocking" at the base of infected stems for an inch or more, and occasionally up to three inches, above the point of origin of the main root system. This discolouration can usually be detected, on close scrutiny, by examining the bases of affected plants just as they are when pulled up from the soil, but the characteristic, more or less shiny, stove-polish-like appearance is best seen by carefully pulling the leaf-sheaths backwards and down so as to reveal the actual stem itself.

Fig 1.—Showing root-rotting and blackening of the bases of stems and leaves of wheat plants attacked by "Take all."

(*Photo by Author.*)

Sometimes, and especially on infected stubble in the autumn of the year following infection, little black spine-like objects will be seen poking through the bases of the leaf-sheaths surrounding the lower portion of the stem. These are the beaks on the seed-cases of the fungi, which are formed on the inside of the leaf-sheaths and project out through the leaf tissue into the open air, so that they may the more readily eject their fungus-seeds (*spores*) when the time comes for the infection of another lot of wheat or other susceptible plants. (See Fig. 2.)

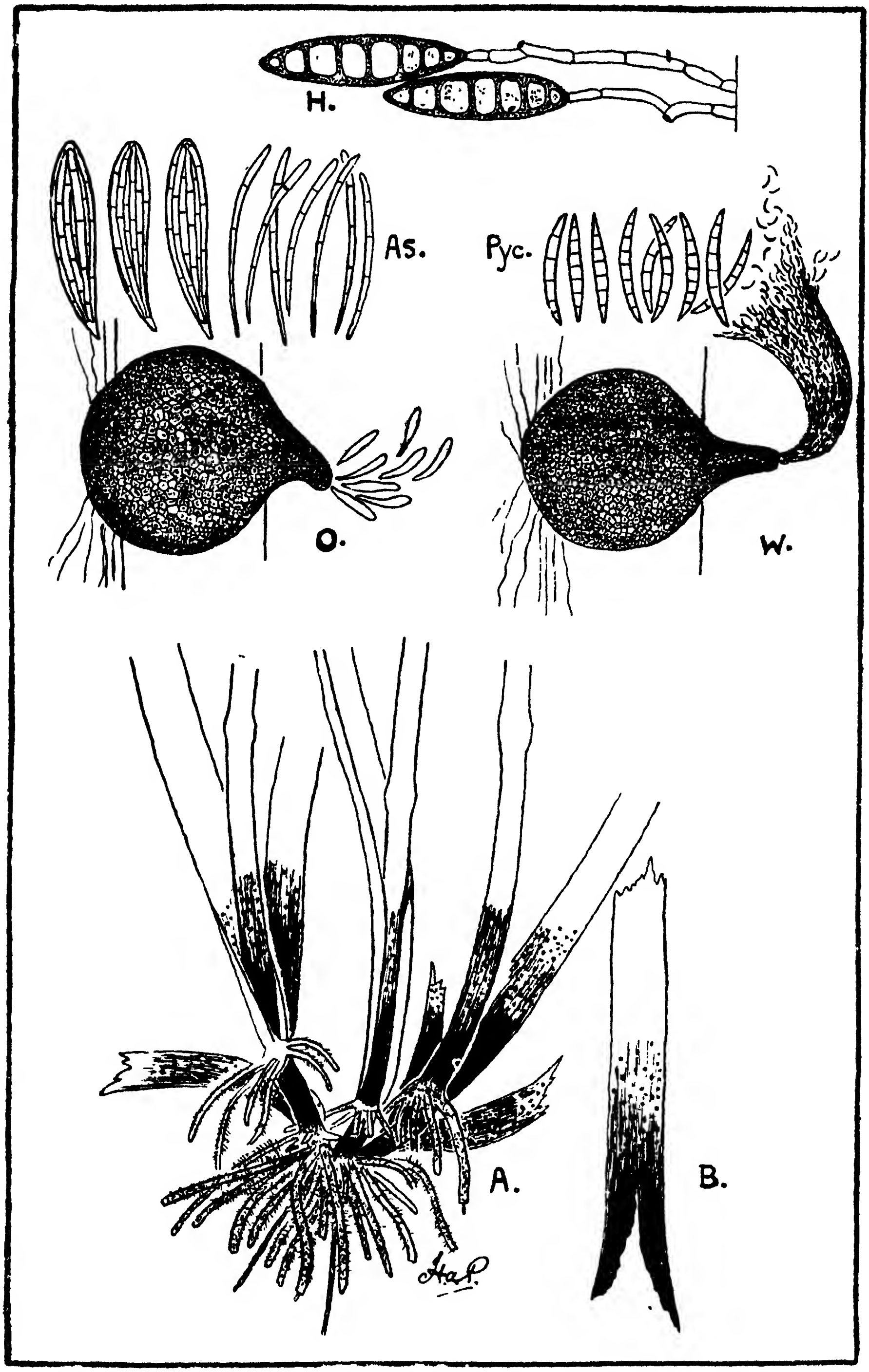


Fig. 2.—A. Wheat plant showing blackening at base of stems and inside the leaf bases due to the "Take-all" fungus *Ophiobolus graminis*. B. Inner surface of leaf-base showing blackening and the fruiting bodies of *Ophiobolus graminis*. O. Fruiting case (*perithecium*) of *Ophiobolus graminis*, with escaping *asci*. W. Fruiting case (*pycnidium*) of *Wojnowicia graminis*. Pyc. Spores of *Wojnowicia graminis*. As. *Asci* and *Ascospores* of *O. graminis*. H. Spores of *Helminthosporium sativum*. All drawings except A and B very much magnified.

In the case of "Take-all," each seed-case (*perithecium*) contains within it large numbers of fungus-seed structures (*spores*), grouped in bundles of eight in thin sheaths called *asci*. (See Fig. 2.) When mature, and the *perithecia* are moistened under suitable conditions, the *asci* with their contained *spores* are forced out into the open. The *asci* then burst and set the *spores* in the bundles free. On germination the *spores* may attack any wheat, barley, rye, barley-grass, or other susceptible plants in the neighbourhood, and so continue the disease. In the absence of any suitable host, however, they soon die. So far as is known, all our wheat varieties are equally subject to "Take-all," but specific information on the point is unavailable. Affected plants usually show considerable root-killing, and an unusually abundant development of woolly root hairs close to the stems. Grain is rarely produced by affected plants and, if so, is small and shrivelled. Oats, under normal, good-growing, conditions, are highly resistant to this disease.

"Take-all" may be found on all types of soil. It is most prevalent during warm, moi[illegible] old land sown dow[illegible] after year. It is [illegible] this State in we[illegible] places, and after a field has been allowed to grow up into grass. It is rare and need never be feared on intelligently farmed, well-drained properties, where early and clean fallowing, "wet sowing," abundant fertilising, shallow planting, and crop rotation are practised as routine matters of farm management.

In the case of "Root-rot," the blackish or dark-brown discolouration of the stem and insides of the leaf-sheaths is usually not so extensive as in the case of the true "Take-all" fungus (*Ophiobolus graminis*), and is more commonly found in spots and streaks, rather than generally distributed over the surface.

The root systems of wheat plants affected by either of the above organisms are always more or less rotted, brown or black in colour, and frequently very woolly, due to the excessively close packing of the root hairs, which have formed in great quantities near the butts of the roots to try and absorb sufficient water and food materials to keep the plants alive "Fruiting bodies" or fungal seed-cases (*perithecia* or *pycnidia*, as the case may be) (see Fig. 2) may be found in both cases under suitable conditions on the diseased roots, as well as on the stems or inside the leaf-sheaths.

So far "Root-rot" has only been found in Western Australia on wheat and barley-grass. With wheat, "Take-all" and "Root-rot" are not infrequently found on the same plants. The latter disease appears to be favoured by the same temperature and moisture conditions that favour "Take-all." The spores in the case of *Wojnowicia* are produced in globular bodies much resembling those found in the case of *Ophiobolus*, but which differ in that they are smaller and may be somewhat hairy, instead of smooth, and do not have the spores produced in bundles. (See Fig. 2.) The spore themselves also differ, as can be seen from the drawings.

"FOOT-ROT."

"Foot-rot" (caused by *Helminthosporium sativum*) may be identified by the presence of one or more characteristic, isolated, light or dark brown streaks or spots near the bases of affected stalks. The base of the stem is often somewhat grey in colour, in addition to bearing the brown spots, and it frequently snaps off very easily from the butts of the roots. A musty odour may also often be detected at the base of the affected stems. The discoloured portions of the stems do not usually extend above ground. The very dark "stocking" which sheaths the base of the stem in the case of "Take-all" or "Root-rot" is quite absent with "Foot-rot." Sometimes a pinkish discolouration, due to the presence of *Fusarium spp.*, will be found at the base of stems affected with "Foot-rot." This

disease may attack the wheat plants in patches as is the case with "Take all" and "Root-rot," or it may attack isolated plants throughout the crop.

Plants may be killed out in all stages of development, and the occurrence of "whiteheads" is a common symptom. (Fig. 3.) The fungus is fortunately only rarely found in Western Australia. It has a very wide host range, and various strains may attack wheat, barley, rye, and many different grasses, including bar-

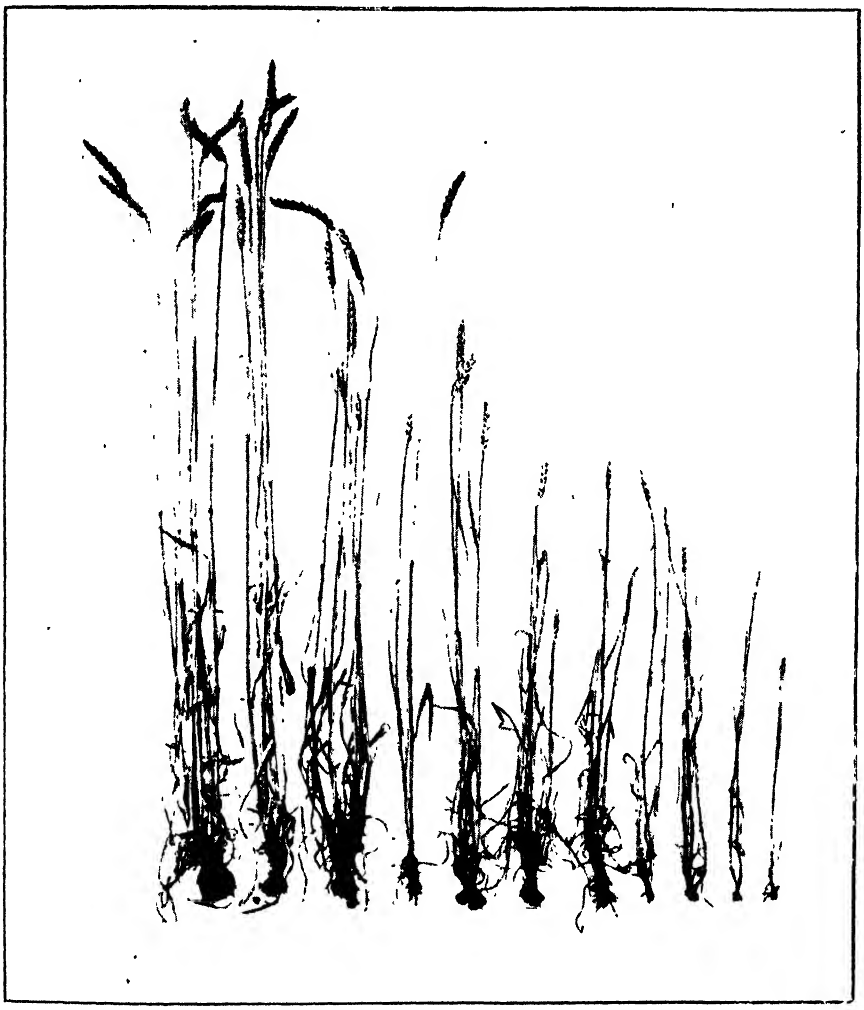


Fig 3.—Showing wheat plants that have died of "Foot-rot, due to *Helminthosporium sativum*, in various stages of development

(*Photo Department of Agriculture, N.S.W.*)

ley-grass (*Hordeum murinum*) and various species of brome grasses (*Bromus spp.*). Oats have not so far been found affected in Western Australia, although same varieties are slightly affected in other parts of the world. In this State the disease has so far only been found on wheat and barley grass. Susceptible

species may be attacked on the roots, stems, leaves, ears, and grains. The disease is most serious under rather high soil temperatures, and in the presence of abundant moisture.

GENERAL CONSIDERATIONS.

The three diseases just described may all cause death of wheat plants at a very early stage in their growth, so that large bare patches may appear very early in the growth of the crop; or they may cause their death at any later stage, with consequent lack of formation of the heads; or again they may lead to the development of whitened leaves, straws, and heads without grain, or the formation of heads with very pinched grain, as the case may be.

No field survey has ever been made in this State of the relative abundance and distribution of the three separate diseases. Specimens of plants affected with "root-rotting" diseases sent in by farmers, however, are for the most part found in the laboratory to be attacked by "Take-all" (*Ophiobolus graminis*); "Root-rot" (*Wojnowicia graminis*) being very much less common, and "Foot-rot" (*Helminthosporium sativum*) only very rare.

In the field the effects of the "Take-all" fungus are usually noticed more early in the season than is the case with the other two, to which attention is more usually drawn by the occurrence of plants in patches, or scattered through the crop, prematurely "whitening-off" towards harvest time.

The stem symptoms described above serve to distinguish wheat plants affected by these parasitic diseases from failures due to water-logging, excessive salt in the soil, soil poverty, frost, or hot drying winds on improperly-consolidated, or moisture-deficient, soil.

CONTROL OF "TAKE-ALL," "ROOT-ROT," AND "FOOT-ROT."

The control measures for the three diseases are sufficiently similar to be considered identical from a practical point of view. Where conscientiously carried out little loss need be feared from any of the three over a series of years, although once they have become established on a farm there may be an exceedingly heavy loss in seasons very favourable for infection.

Unfortunately, as stated above, these diseases cannot be controlled by the use of seed treatment, as recommended by the Department of Agriculture for "bunt" or "ball smut," or by the use of resistant varieties, as recommended for "flag smut" and "rust." Their control can be summed up in the sentence, *"Starvation of the fungus and the adoption of all those cultural methods which experience has demonstrated provide for the ideal development and growth of the wheat plant."* Disappointment will result if reliance is placed on any one method. Success will depend on the intelligent employment of the following interdependent practices.

1. **A good, clean, stubble-burn in badly-affected patches or paddocks.**—Where only small patches occur, straw from the neighbouring healthy areas should, if possible, be distributed over the diseased areas before firing, so as to make a more intense burn over the badly-affected patches. (Where the disease is serious, there is, of course, only a limited amount of stubble formed, so that the necessity for some additional material for burning is obvious.) The object of a stubble-burn is to destroy as much as possible of the diseased roots and the lower parts of the infected stems and leaves. These are the parts which carry the fungi. The latter do not die with the plants but live either as fungal threads (*mycelium*), or in *spore* (seed-like) form in the dead wheat

tissues. If not burnt, the infected parts of the stubble may be blown about the paddock and into other paddocks, especially if broken up by the trampling of sheep and horses. The headlands should also be burnt to destroy self-sown wheat or barley plants, barley grass, brome grasses, silver grass (*Festuca bromoides*), etc., which may be harbouring "Take-all," "Root-rot," or "Foot-rot."

Paddocks which have been allowed to go to pasture should preferably be burnt, when possible, before being fallowed, as the growth of such host plants as barley grass, spear grass, silver grass, and a number of other grasses, is one of the most rapid means of greatly increasing the "root-rotting" diseases on wheat paddocks.

While recognising to the full the value of a stubble-burn as an initial step in the cleaning-up of paddocks where "Take-all" and similar diseases have been allowed to get the upper hand, the writer wishes to emphasise, in no uncertain manner, that the indiscriminate and repeated burning of the stubble as a routine practice, year after year, cannot be too strongly deplored, owing to the very serious reduction in soil fertility and marked deterioration in the physical properties of the soil which may result from the repeated destruction of humus, on the content of which the fertility and good physical condition of the soil to a very great extent depend.

2. **Early Fallowing.**—The importance of this measure cannot be over-emphasised. Results of experiments at the Merredin Experiment Farm show an increase of approximately five bushels per acre on early-June-fallowed plots as against those fallowed in late August: the occurrence of "Take-all" on the early-fallowed plots being also very markedly reduced. From a disease point of view the main object of early fallowing is to plough under infected stubble and induce the fungus seeds, or spores, which are produced on the bases of the stems and roots of infected plants, to germinate. Having germinated in the moist soil, these spores must soon find some susceptible plants close handy to attack or else die of starvation.

Unfortunately, a stubble-burn does not destroy all the affected stem-bases, leaf-bases or roots, so that a burn is not sufficient in itself to effectively control these diseases. It is therefore necessary to follow up the stubble-burn by early ploughing in the late autumn or early winter, whenever possible, so as to turn the spores under into the moist soil. This does not cause them to rot, as might be supposed, but induces many to germinate. *If the first ploughing is left till the spring the soil may be too dry to induce copious germination, and many of the spores may not germinate till the following winter, thus putting back the control of the diseases for another year.* Once the spores have germinated they must find something to attack or die of starvation. This brings us to the third point in the control measures, viz.:—

3. **Clean Fallowing.**—It is absolutely essential that all growth should be destroyed by thorough cultivation, and the judicious use of sheep, in the winter and early spring, as otherwise the growth of susceptible plants on the fallows, such as self-sown wheat, barley, barley grass, etc., is simply breeding up and multiplying the various "root-rotting" fungi for the following year.

If ploughed in the late autumn or early winter, or even if left unploughed till the spring, the winter rains will have induced a more or less plentiful growth of self-sown wheat, barley grass, brome grasses, silver grass and perhaps barley. *These plants may be attacked by the spores already ploughed in, and, in such a case, unless the plants are killed out by clean cultivation, the fungi will eventually form a new crop of spores. Therefore the fallows should be kept free from all growth in the spring.* From July to November, in a cool, moist spring.

or to October in more normal years, it is dangerous, from a disease point of view, for grasses to grow on infected fallows. After that the very high temperatures of the summer will usually prevent both the susceptible plants and the fungi developing.

4. **Avoidance of "dry working" of fallowed or stubble land.** Unless absolutely imperative for the eradication of weeds or the carrying out of some other essential farm operation, *it is most important that the fallows or stubble land should not be worked dry*, as under such conditions the infected stubble, which is very brittle, is broken up into numerous small pieces, which are then blown about by the wind and cause a very rapid increase in the size of the "Take-all," "Root-rot," or "Foot-rot" patches, and bring about an extension of the diseases on to hitherto clean areas. From a disease-control point of view, dry working of the fallows or stubbles cannot be too strongly condemned.

5. **Rotation of wheat with crops not susceptible to these diseases.** The growth of a crop of oats, peas, rape, lupins, lucerne, cluster clover, or any other suitable plants not belonging to the Grass Family, following the steps already discussed, viz., a good, clean, stubble-burn, and early and clean fallowing, will give another season for any remaining spores in the soil to germinate and die. Oats have not been found affected by "Root-rot" or "Foot-rot" in this State, and they are to all intents and purposes immune from "Take-all." Oats are at present the most practicable crop for rotation purposes. None of the other plants mentioned above is subject to any of the three diseases.

After the rotation crop the paddocks should preferably be early- and clean-fallowed before again coming back into wheat.

6. **"Wet-Sowing,"** i.e., sowing wheat after the commencement of the autumn rains, not before, when the season allows, gives any fungus spores that may still remain in the soil a further chance to germinate and die before the wheat is sown or germinates.

The variety selected should be planted as *late* as is permissible for the district according to the recommendations of the Wheat Branch of the Department of Agriculture. It is advisable to choose an early or very early maturing variety for planting on paddocks where serious losses from "Take-all," "Root-rot," and "Foot-rot" have been experienced, because these varieties can be planted later with safety than is the case with later-maturing varieties.

7. **Heavy dressings of superphosphate.**—As much superphosphate should be used on "Take-all" patches or paddocks as the farmer can afford, as the "Take-all" fungus is definitely suppressed by any substances which tend to increase, even temporarily, the acidity of the soil. Moreover, extra superphosphate stimulates a vigorous rooting system and induces very considerable disease-resistance, so that the plants are very much better able to resist the attacks of the "Take-all," "Root-rot," and "Foot-rot" organisms. These diseases are always very much more serious on wheat plants which have been weakened in any way, such as by the water-logging of the soil, too deep planting of the seed, severe frosting during the spring, or too little use of superphosphate.

It has been shown by Kirby in America (Cornell Uni. Agr. Expt. Sta. Memoir. 88, 1925) that, although "Take-all" can be grown in artificial media with a wide range of acidity or alkalinity, it prefers somewhat alkaline conditions.

During the 1931 season it was found at the Merredin Experiment Farm that where "Gluyas Early" wheat had been planted across a "Take-all" patch

without superphosphate the wheat was a failure. Where 75 lbs. of superphosphate were used "Take-all" was serious. Across the same patch where 150 lbs. of superphosphate were used very little "Take-all" could be found, even on close scrutiny.

8. **Good drainage** is essential on heavy forest country, as where the water tends to lie on the surface for any length of time the effects of the three fungi herein discussed are always very much more severe than on well-drained land.

9. **The wheat seed should be planted on a very well compacted seed bed,** about 1½ to 2 inches deep. This is very much more important than many farmers realise. The thorough preparation of the seed bed, so that there is at seeding time a very firm seed bed about 1½ inches below the surface mulch, is one of the most important factors in ensuring a good even germination and the development of strongly-rooting, abundantly-vigorous, disease-resistant plants. The sowing of wheat on a properly consolidated seed bed stimulates vigorous root development, and by giving the plants a good start in life tends to render them more resistant to the inroads of the fungous diseases herein discussed.

If planted deeper than about 1½ inches, considerable time and energy is wasted by the young seedlings in developing their permanent root system at the 1½-inch level, which they will always do no matter how deeply the seed is sown. If the permanent root system is thus forced to develop in a very poorly compacted and over-aerated region of the soil, the resistance to "Take-all," "Root-rot," and "Foot-rot" is very greatly lowered.

10. **Do not feed-off crops on affected land,** as the reduction in the vigor of the plants which is caused by this practice will result in any "Take-all," "Root-rot" or "Foot-rot," which may be present, causing a very much greater loss of yield than would be the case had the crop not been fed-off. These diseases can be present on wheat plants without doing them any very great amount of damage, if the infection is only slight, but anything which reduces the vigour of the plants may allow the fungi to get the upper hand. Similarly, anything which will tend to increase the vigor of the plants will tend to cause them to throw off these diseases.

11. **If cutting infected crops for hay, set the reaper and binder to cut not closer to the ground than four or five inches,** so that diseased tissues will not be spread about the farm on the hay, chaff, or in the droppings of animals.

12. **Avoid the dumping or stacking of bags containing wheat or chaff in bare patches in the paddocks caused by "Take-all" and similar diseases,** as small pieces of infected material may become caught up in the fibres of the bags and be distributed in that way to other parts of the farm, or to new farms, later on.

13. **Finally, on no account should paddocks affected with "Take-all," "Root-rot" or "Foot-rot" be allowed to go to pasture.** Such a procedure does not tend to remedy the position but only makes the diseases worse, as most of the grasses which grow up on pasture land, such as barley grass, spear grass, silver grass, etc., become infected with the diseases without actually being seriously injured themselves. Pasture on "Take-all," "Root-rot" or "Foot-rot" patches or paddocks therefore makes the diseases worse, instead of better, when wheat is again grown on those areas. It is very much better, from the disease point of view, to adhere to a two-year rotation, i.e., fallow, wheat, fallow, wheat, than to adopt the three-year rotation, fallow, wheat, pasture, where "Take-all" and the similar diseases exist.

To let an infected area go to grass does not only not check the disease on that area, but it is liable to infect adjoining areas through infected fragments of the grasses being blown about by wind, or carried to them on the implements or by stock, etc. (See Fig. 4.)

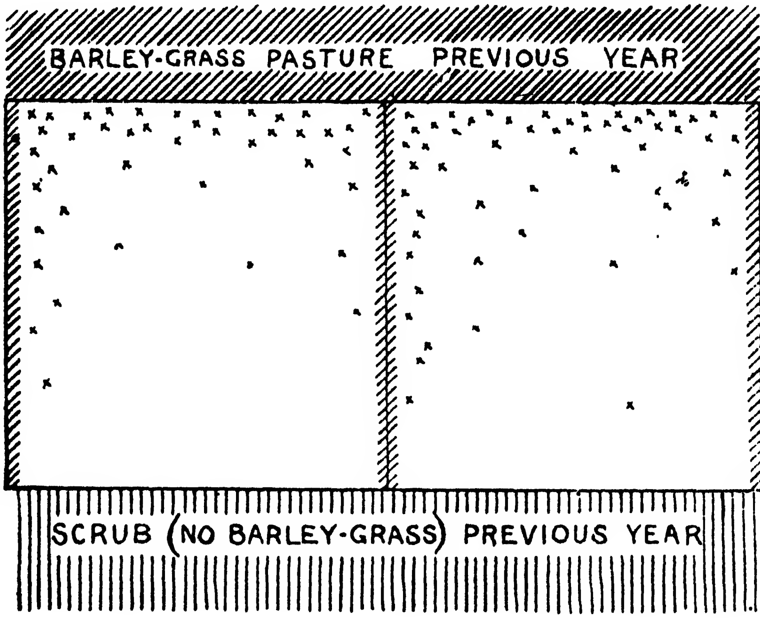


Fig. 4.—Diagram illustrating the manner in which two fields were affected with "Take-all." The crosses indicate the distribution of "Take-all" patches, but are not accurate plottings.

(*After G. Samuel, "Take-all Investigations 2." Journ. Dept. Agric S. Aus., July*, 1924, *pp* 1134-1147.)

After breaking up grass paddocks the first crop should be oats, where possible, not wheat.

14. **Never plant discoloured, shrivelled seed,** as "Foot-rot" may cause such symptoms and be introduced on to new areas in infected seed.

15. If it is ever absolutely necessary for any reason to plant wheat after "Take-all," "Root-rot" or "Foot-rot," without the intervention of an early, clean, fallow, such as recommended above, the best methods are:—Stubble burn, thorough preparation of the seed bed *after rain*, shallow planting, the planting of early-maturing varieties as late as is permissible for the district according to the recommendations of the Wheat Branch of the Department of Agriculture, and heavy applications of superphosphate.

If all the above recommendations are carried out conscientiously—and many of them are simply practices which should be carried out in the ordinary routine of good modern farming, quite apart from all considerations of disease —"Take-all," "Root-rot" and "Foot-rot" will be very greatly reduced in amount if not entirely eliminated from the wheat fields.

It is very much better, in every way, to farm a smaller area thoroughly than a larger area in a skimpy and slip-shod manner.

REVIEW.

"THE USE OF FERTILISERS IN TROPICAL AND SUBTROPICAL AGRICULTURE,"

By A. JACOB, Ph.D., and V. COYLE, M.Sc., 1931.

Statistics show that generally those farmers using most liberal dressings of fertilisers are most successful in agricultural practice. In view of the low prices for agricultural products ruling to-day and the need for the dissemination of information concerning fertiliser practice, Jacob and Coyle have assumed the task of preparing a handbook on this subject for the use of planters in order to raise the productivity of the soil and improve the quality of the produce. A representative literature has been used in reference.

Part 1 deals with the theory and practice of fertilisers and fertiliser experiments.

Contrary to general notions of those outside the tropics, it is observed that many soils in tropical and subtropical regions are inherently of low fertility owing to extreme leaching under high temperature conditions. The need for organic and inorganic fertilisers is suggested and the position with respect to a wide variety of crops is studied in Part 2.

In Part 2 the authors elect to prove that "rational manuring with artificial fertilisers" will be "an effective help for the solution of the big problem of reducing the planter's cost of production." From a consideration of the amounts of nitrogen, phosphorus and potassium removed from the soil by various crops, a knowledge of the physiology of the plants and a selected number of experimental results, recommendations are made for the guidance of planters. It is not claimed that the mixtures recommended will suit all conditions, but they are given to assist in the laying out of experiments on the individual holdings to determine local requirements.

Practically all of the experiments cited show the value of "complete" fertilisation and considerable emphasis is given to the return from the use of potassium in the mixtures. It is open to question whether many of the experiments described were sufficiently controlled to warrant the conclusions derived.

The book is not a contribution to the scientific aspects of fertilisers—it is not intended to be so—but it is a useful guide for the use of planters and farmers interested in understanding fertilisers and in improving the fertiliser practice as a means of lowering production costs.

L. J. H. TEAKLE.

25/1/32.

RELATIVE FOOD VALUES.

G. K. BARON-HAY and L. C. SNOOK.

Although figures relating to the Cost of Production of Milk and Butterfat appearing elsewhere in this *Journal* indicate that an effort should be made to grow all foodstuffs on the farm, during the summer months it is sometimes necessary to purchase considerable quantities of concentrated foodstuffs, in order to maintain the milk production of herds. It is difficult sometimes to decide which type of foodstuff to buy.

For many years bran was considered an indispensable constituent of the summer ration and was purchased in regular quantities, whatever may have been its price relative to that of other foodstuffs. In recent years, however, dairy farmers have learnt that other concentrates may successfully replace bran, the deciding factor being one of cost only. Oaten and wheaten grain, peas, and linseed meal mixed in various proportions may be used as substitutes for bran.

To aid farmers in deciding which concentrate to purchase, the following table has been drawn up. The table shows the current price of each food and the value per food unit.

Relative Values of Concentrates for Dairy Cattle, 1st March, 1932.

Food.	Cost—1-3-1932.	Digestible Protein in 100lb. of Foodstuff.	Food Units per 100lb. of Foodstuff (Wood.)	Cost of 100lb. of Foodstuff.	Cost per Units of Protein.	Cost per Food Unit.
		lb.		s. d.	d.	d.
Wheat	3s. 4d. per bus. (60lb.)	9·0	72	5 6¼	7·4	0·93
Oats	2s. per bus. (40lb.) ...	7·0	60	5 0	8·6	1·00
Bran	£5 10s. per ton ...	9·0	50	4 11	6·5	1·18
Meggitt's Meal ...	£12 10s. per ton ...	26·0	76	11 2	5·0	1·76
Peas	5s. per bus. (60lb.) ...	17·0	72	8 4	5·9	1·19
Meatmeal ...	7s. 9d. per bag (50lb.)	40·0	62	15 6	4·65	3·00

The nature of the concentrate required will vary. A farmer may have ample supplies of cereal hay (say, 1½ tons per cow), cereal silage and a little dry picking in his paddocks. The milch cows on such a farm will require a protein supplement, and the figures given in the table showing cost per unit of protein will prove of value. It will be seen that at the present time linseed meal is—with the exception of meatmeal—the cheapest source of protein. As linseed meal is an ideal supplement to a ration of cereal hay and silage, its present cheapness warrants its use.

Meatmeal originally was placed in the table as being of probable value to pig-raisers, but there does not appear to be any reason why meatmeal should not be used as a protein supplement for cows. Theoretically, meatmeal should be ideal for this purpose, as it contains—in addition to the protein—about 40 per cent. of mineral matter (as calcium phosphate), likely to be of great value to a lactating

cow or growing calf. The fat present (about 11 per cent.) would render meatmeal unpalatable to cows if fed in quantity, but such excessive feeding is not likely to occur in practice. It would be very interesting to test the value of meatmeal as a concentrate for dairy cattle, and it is hoped that it will be given a trial. It is the cheapest protein concentrate on the market at present.

Peas at 5s. per bushel is also a cheap protein food. They are included here, not as an indication that peas should be purchased but to stimulate the growth of peas by the farmer. A few acres of field peas are a splendid asset on any farm. With good cultural methods 20 to 30 bushels of grain per acre should be obtained, and the pea culms remaining will prove a valuable addition to the reserve of hay. Ten acres of peas yielding 20 bushels per acre will supply enough grain to feed 3 lb. per head per day to a herd of 20 cows for six months. Crushed peas are an ideal supplement where a farmer feeds good chaff and silage.

At £5 10s. per ton, bran is a cheap protein food. As it has other well-known virtues, being laxative and stimulative of milk flow, its use is quite economic at this price.

Oats appear expensive—indicating that oats should be grown on the farm. Oats are a splendid food for stock, but at present rates (2s. per bushel) are expensive to buy.

Now that the growth of clovers and similar protein rich fodders is becoming so general, and the conservation of clover hay is part of standard dairy farm practice, the need for a protein rich supplement is not so widespread. It is often necessary, however, to feed some concentrate to high producing cows. Under such circumstances, the value of the concentrate will not depend on the protein content alone but also on the total food value—the number of palatable, easily digested food units per pound of purchased foodstuff. The last column of the table shows the various foods evaluated under this heading. It will be seen that linseed and meatmeal, purely protein foods, are far too dear for use in this class. Wheat is the cheapest and is certainly more economical to purchase than poor quality oats Crushed wheat is a suitable food for dairy cows, but should not exceed one-third of the grain ration. Good oats at 2s. per bushel are not much dearer than wheat. Bran is an expensive supplement to a clover hay ration, and, like linseed meal, should be used only to counteract a shortage of protein.

Meatmeal is the cheapest and best source of protein for pigs, and is the correct supplement for a grain ration. It has the added advantage of supplying necessary minerals lacking in a cereal grain diet. 3 lb. of crushed wheat and 4 ounces of meatmeal will supply all the requirements of a 50 lb. pig growing at the rate of 1 lb. per day. This ration now costs about 2½d. per day.

It is intended that a similar table to that discussed in this article will be printed in future copies of the *Journal*. It is hoped that reference to it will aid farmers, who have to purchase concentrates, to buy that which is cheapest at current market rates.

BACTERIAL BLIGHT OF BEANS.

DISEASE-FREE SEED AND DISEASE-FREE SOIL ESSENTIAL FOR CONTROL.

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

Prior to the 1930-31 season the "Canadian Wonder" bean crops (*Phaseolus vulgaris*, L.) in this State had always been, so far as is known, quite free from any bacterial disease. In November, 1930, however, complete losses of crops of this variety were caused at Maddington by a disease which was readily diagnosed as a "bacterial blight," although, owing to pressure of other matters, no opportunity has as yet occurred of definitely identifying the bacterium concerned. It would appear, however, that at least the major part of the losses was due to *Phytomonas medicaginis* var. *phaseolicola*. The seed from which these crops were grown had been obtained from Orbost, Victoria, where a huge, and, up till then, extremely satisfactory bean seed-raising industry had been established.

Shortly after the first outbreak of the disease in this State, news came to hand, per medium of the Eastern States press, that total crop failures had been reported during the 1930-31 season from South Australia and many parts of Victoria, due to the ravages of a bacterial blight. A similar, and perhaps the same, disease, caused by *Phytomonas medicaginis* var *phaseolicola*, has since been reported from New Zealand (W.D. Reid, N.Z. Journ. Agric., Vol. 43, No. 6, Dec., 1931, pp. 408-415), and Queensland (L. F. Mandelson, Queensl. Agric. Journ., Vol. 37, Part 2, pp. 128-33, Feb. 1932), and a bacterial blight has led to very severe losses in the big bean-growing district of Gosford, New South Wales.

Samuel (Journ., Dept. Agric., South Aus., Vol. 34, No. 7, Feb., 1931, p. 746) records a bacterial spot of beans in South Australia as being probably due to *Phytomonas medicaginis* var. *phaseolicola*.

Since the first occurrence of the disease in this State very severe losses have occurred at Nedlands in extra early crops of "Canadian Wonder" beans, and also of the same variety at Geraldton, Balcatta, Spearwood, and other places.

The seed-raising industry at Orbost, Victoria, has been completely disorganised, and the Victorian and New Zealand Departments of Agriculture have instituted Seed Certification Schemes in an endeavour to provide seed buyers in the future with disease-free seed.

Investigations under way by the Department of Agriculture in Victoria, according to a letter from the Plant Pathologist, Mr. D. B. Adam, include varietal resistance trials, seed treatments, spraying and dusting experiments, the use of aged seed, and various systems of rogueing.

SYMPTOMS OF THE DISEASE.

On entering a field severely affected with bacterial blight, the first impression gained is that the germination has been very irregular, and that the affected plants are suffering from nitrogen starvation combined with the effects of an exceedingly severe drying wind, although it may be very well known to the observer that neither of these things could possibly be the cause of the trouble. In a number of patches where the disease obviously first appeared, all that is left of the affected plants will be a few stiff stems with shrivelled and dried-out leaflets still hanging to, in some cases, or else fallen from, the leaf stalks or petioles, which usually remain stiffly erect. A number of the plants may have grown little, if any, further than the seed-leaf stage.

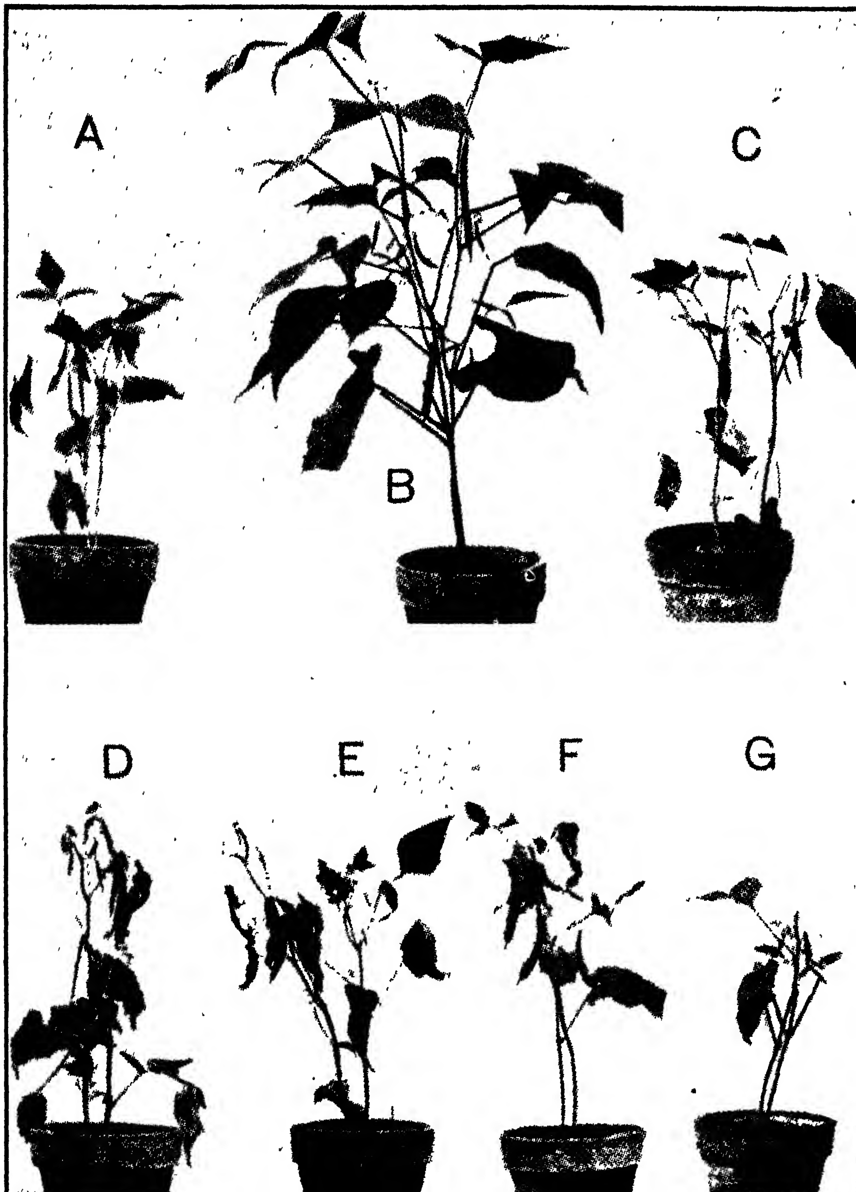


Fig. 1.—Wilts of "Red Kidney" bean plants one month after inoculation with various bacterial pathogenes.

The plants were inoculated at the first leaf node A, *Phytomonas medicaginis* var. *phaseolicola*; B, check; C, *Phyt. phaseoli* var. *fuscans*; D and E, two strains of *Phyt. phaseoli*; F and G, two strains of *Phyt. flaccumfaciens*.

B represents a perfectly healthy uninoculated control plant photographed on the same scale as the others.

(*After Burkholder, "The Bacterial Diseases of the Bean," Cornell University Agric. Expt. Sta. Memoir* 127, *April*, 1930.)

A number of the leaves may have fallen away from the plants at the abscission layer near the base of the leaf-stalk (petiole), while in other cases the leaflets will have dropped off with their own stalks (petiolules), leaving the petioles projecting stiffly into the air. The swellings at the base of infected petioles may be very much watersoaked in appearance and still quite green, even though the end of the petiole is browned and shrivelled.

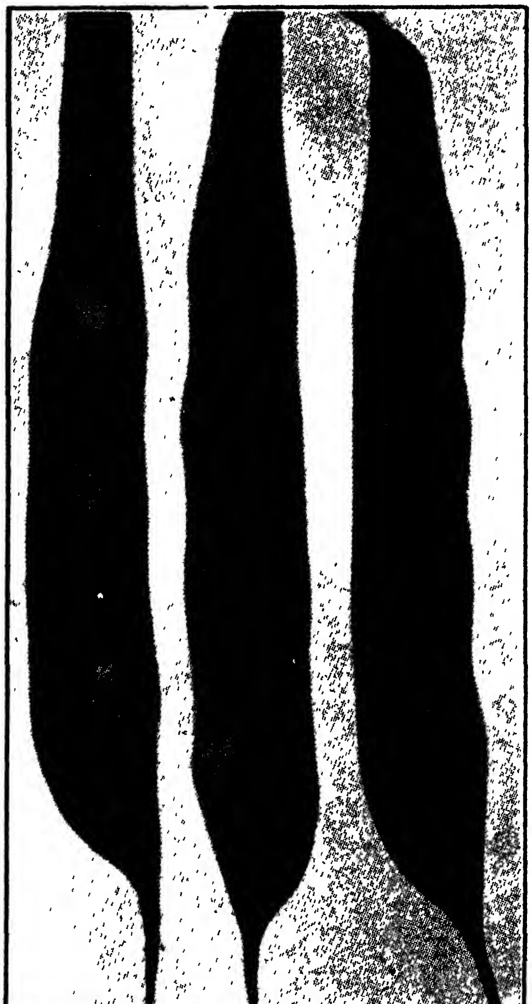


FIG. 2.—Pods of "Red Kidney" bean showing lesions caused by *Phytomonas medicaginis* var. *phaseolicola*. (*After Burkholder, "The Bacterial Diseases of the Bean," Cornell University Agric. Expt. Sta. Memoir* 127, *April*, 1930.)

If the weather conditions are moist at the time, or if the plants are growing in a very moist situation, or have been recently heavily watered with a sprinkler, beads of bacterial slime may be found exuding from the nodes on the stem, just below the bases of the petioles, or from the wounds left by the falling away of the leaflets, leaves or cotyledons (seed leaves). Elongated,

very irregular, slightly sunken, brown lesions with a reddish-brown margin may occur on the stem, and a more or less complete brown girdling of the stem with a reddish margin and considerable bacterial ooze may be located at the point where the seed leaves were formerly situated. Some of the leaflets which have not yet dried out may show a considerable number of rusty-brown, more or less confluent, small irregular lesions between the veins, the remainder of the leaflet having a very sickly, nitrogen-starved, mottled appearance. Such leaves are frequently very ragged at the margins and "shot-holed" in appearance. Small, dark-green watersoaked, or dead, areas may occur on the leaflets, each spot being surrounded by a comparatively enormous pale-green halo.

Affected pods may show one to very numerous more or less circular dark-green watersoaked lesions, from which bacteria may exude in beads in moist weather, in a very moist situation, or when placed for a day or so in a moist jar.

These areas later on may dry out and become more or less reddish or brown in colour. The diseased areas may run together and cause malformation and withering of the infected pods.

Early sown and late autumn crops are generally the most severely affected, as the cool, moist, atmospheric conditions are more favourable for the spread of the disease than hot, dry, conditions. The danger from bacterial blight is greatest in the localities which would otherwise be the most suitable for the production of very early crops, that is in the frost-free coastal areas and picked spots close to the Swan River or other favoured locations. The disease is apparently spread about in the field from the primarily-infected plants by driving rain, hail, overhead watering, insects, or cultivation and harvesting operations when the plants are in a moist condition. The spread of the disease in the field under suitable conditions may be exceedingly rapid.

CONTROL.

The disease is carried by the seed, and the only known control measure is to plant seed harvested from disease-free crops, on new land, or land that has not grown an infected crop for at least three years.

Since infection is not only carried on the outside of the seed, but actually in a number of cases inside the seed coat, seed disinfection is impossible, as any treatment severe enough to kill the bacteria within the seed coats would also kill the seed.

The appearance of the seed may give no indication as to whether the disease is present or not, as perfectly healthy-looking seed may be carrying sufficient infection to give total crop failure under suitable climatic conditions.

Bacteral blight can only be detected with any degree of certainty in the seed by a long and tedious laboratory investigation, or, better still, by actually growing a representative sample of the seed in disease-free soil prior to the planting of the bulk, and carefully observing the test seedlings for any signs of disease. In the seedlings bacterial blight may be recognised as small diseased spots which develop on the cotyledons (or seed leaves), which are attached to the top of the stem when the seedling stem appears above ground.

In view of the serious result that will almost inevitably attend the introduction of even a small percentage of infected seed on to a property, **growers who know that their land and crops are clean are strongly advised to raise their own seed, even though it may be contrary to their practice and inclination to do so.** It is important to remember that bacterial blight is carried almost solely by the seed, and properties that are now clean may therefore be kept so perhaps indefinitely by the expedient of planting only clean seed.

Clean seed may perhaps be obtained from an originally diseased line, by growing a crop during the hot dry weather, provided that artificial waterings, if necessary at all, are kept down to the irreducible minimum, and that the diseased plants are pulled out and burnt as soon as noticed. Frequent inspections should be made as soon as the seed has germinated, and any weak or sickly plants, as well as plants with spotted seed leaves, or with blight spots on the leaves or stems, should be carefully removed and immediately destroyed by fire or boiling. Bean plants should never be worked amongst when any moisture is present on the leaves, as infection may easily be spread in this way.

Growers whose crops are infected should burn all diseased plants, and should not plant the infected land to any variety of beans for at least three years.

Regarding varietal susceptibility, Dr. R. J. Noble, Biologist, Department of Agriculture, New South Wales, in a letter to the writer dated 13th November, 1931, says—

> "Bacterial blight of bean has been very prevalent in this State during the last two seasons, and at present is so widespread in 'Canadian Wonder' crops that only limited supplies of beans are reaching the market. The disease first came under notice in this State in 1928.
>
> "Field observations have been made by this Department on relative resistance in about 200 varieties and selections of beans for two seasons, *but no variety has shown outstanding resistance.*
>
> "'Kentucky Wonder' and 'Epicure' pole beans have been among the most resistant.
>
> "Most lots of 'Canadian Wonder' bean seed on the New South Wales market at present are infected to a greater or lesser extent, but most of the fancy beans are blight-free so far . . . . . It is understood that most of the seed of the fancy types is imported from overseas.
>
> "It is considered that beans will continue to be a very unsafe crop until disease-free seed can be raised."

Mr. D. B. Adam, Plant Pathologist of the Victorian Department of Agriculture, in a letter to the writer dated 16th November, 1931, advises that—

> ". . . . . field observations suggest that the green bush beans 'Pale Dun' and 'Feltham's Prolific' are more resistant to bacterial blight than the 'Canadian Wonder.' The green bean trade is not so keen on these varieties because the pods in the case of 'Pale Dun' are smaller, and in the case of 'Feltham's Prolific' less fleshy than those of 'Canadian Wonder.'
>
> "Among waxpod or butter beans we find that the 'Startler,' though certainly not immune from bacterial blight, is fairly resistant."

So far we have only experienced bacterial blight on the "Canadian Wonder" in Western Australia.

In conclusion, I cannot too strongly emphasise that unless growers can obtain absolutely disease-free seed (as for example seed certified by a Government Department of Agriculture to be blight-free), and plant it on disease-free soil, they would be very well advised to give up growing "Canadian Wonder" beans altogether, and confine their attention to the other varieties mentioned above as being somewhat resistant. Even then, large-scale planting should be avoided, except with seed known to be disease-free, as in view of the seriousness and rapidity of spread of the bacterial blight disease, bean growing is at present, under any other conditions, far too much of a gamble. The advice given above applies particularly to early or late-planted beans. There were many failures last season owing to neglect of this advice.

PERTINENT TOPICS.

GEO. L. SUTTON,
Director of Agriculture.

THE AUTUMN WORKING OF NEGLECTED AND OTHER FALLOWS.

The effects of low prices and the general depression have been reflected in some of the land which has been fallowed, or rather, imperfectly fallowed, for seeding during the current season. In many instances the initial breaking up of the land, the thoroughness of which is important, has not always been well done and the consequence is that the ground in some cases is very rough, and in most cases is covered with dry weed growth or filled with weed seeds.

The treatment which this land will receive between now and seeding will have a very material effect upon the yield of the resultant crop, and there are some who fear that such land is hardly worth cropping. This, however, is not the case, for, whilst the land so treated may not have the maximum amount of moisture stored in it, nor contain all the available nitrogen which good fallow has, yet it is to be remembered that, usually, poor fallow is better than no fallow at all, and provided the ante-seeding treatment is such that it controls the weed growth and tends to consolidate the seed bed, good crops consistent with the quality of the land and the character of the season are possible.

The natural agencies of rainfall and time will tend to bring about consolidation. If the ground is lumpy some assistance should be given by the cultivation of the soil to break up the lumps. This work can be done even before the rains come, provided the implements available are such as will enable the land to be dealt with effectively should it be hard. If the ground is at all loose, the springtyne cultivator is very suitable for this purpose.

No amount of cultivation whilst the ground is dry will, however, destroy the weed growth which will subsequently result from the seeds which are now in the seed bed, for it must be remembered that, fundamental to practical methods for the destruction of weeds, is a recognition of the fact that though weed seeds cannot be destroyed by cultivation, the weeds resulting from the germination of these seeds can easily be destroyed in their early stages. To make use of this fundamental fact, one must wait until the rains come, to allow sufficient time for the seeds to commence germinating, and then commence cultivations so as to destroy the plants resulting from such germination.

The cultivation for the destruction of weeds must be very thorough, and must be done by implements which are suitable for the purpose, and which, in addition to thoroughly working the soil, will destroy weed growth. Whilst the weeds are young and the ground is soft, the springtooth cultivator, with wide points, is quite satisfactory, provided the workmanship is good, but, as the weeds become more developed or the ground becomes hard, this implement will be less effective, and other machines designed for heavier conditions will have to be used. Because disc implements have a tendency, particularly on clay land, to make the ground too fine on the top, and then eventually to "set," a rigid tyne "duckfoot" or share cultivator is preferable to the disc.

A single cultivation after rain is, however, not all that is necessary, for the result of the first cultivation, while destroying one batch of weeds, is to bring about conditions which will help the growth of weed seeds not previously germinated, and so a second cultivation, preferably at right angles to the first, at a later date, say a week to a fortnight later than the first, is advisable in order to ensure a clean seed bed which is so essential to good yields. This second cultivation can take place and usually does take place immediately prior to seeding.

Whilst each cultivation should be thorough, it does not necessarily follow that it should be deep. A good even mulch of two inches is sufficient at this time. Deeper cultivations should be avoided because such bring weed and disease seeds to the surface layers where the conditions for germination are more favourable, whereas if left in the deeper layers most, if not all of them, would have remained dormant.

Summed up, the treatment to give these neglected fallows in order to secure the best results from them is:—

(1) If rough, to cultivate them prior to the autumn rains, and

(2) Wait for the rains, then thoroughly cultivate 1½ to 2 inches deep a few days after the first rains, followed by a second cultivation, about 1½ inches deep, from a week to a fortnight later, immediately prior to seeding.

"TAKE-ALL" AND OTHER CEREAL ROOT ROTS.

The Importance of Wet Cultivation Prior to Seeding for their Control.

Of the several cultural operations which are necessary to control the disease known as "Take-all," the importance of timely wet cultivation just before seeding cannot be over emphasised. This is the semi-final link in the chain of protection, and is the more important when some of the preceding links in the chain have only been imperfectly dealt with.

On most farms it is probable that, in the autumn, the soil contains more or less spores or seeds of the "Take-all" fungus which are lying dormant, ready to start into activity with the first seasonal rains. These fungus seeds or spores have to be treated very similarly to the seeds of weeds, inasmuch that cultivation will not kill them whilst they are in the form of spores, but the desired result can be achieved, as in the case of weed seeds, by allowing them to germinate and then destroying the host plants to which they may have attached themselves. Obviously, as the fungus is a parasite, the germinated spore will perish unless it becomes attached to a host plant.

To control any of these "Take-all" diseases it is essential to delay seeding until the rains come and allow the spores an opportunity of germinating, attaching themselves to the host plants, a process which only takes a few days, and then to cultivate the ground so as to destroy the host plants or weeds and the fungus at the same time. This, however, is not quite sufficient, for recent investigations have indicated that the mycelium of the disease which, in infected plants, is found on that portion of the stubble below the surface of the ground, as well as on the bases of the stems above ground, is carried over the summer in a dormant condition. With the advent of the autumn rains this bursts into activity, throws out spores and they in their turn are a second source of danger until destroyed. They can be destroyed, as were the first spores, after they have germinated and attached themselves to some host plant such as barley grass or self-sown wheat. For this purpose a second cultivation is necessary, just as the second cultivation after rain is for the destruction of wild oats or other weeds. The double cultivation after rain, which is so beneficial and essential for the control of weeds on "dirty" fallows is also one of the important factors in the control of "Take-all" diseases.

The final link in the chain of protection is the liberal application of superphosphate with the seed, for it has been found that this brings about a soil condition, immediately around the seed, unfavourable to the growth of the fungus.

A double cultivation after rain will, in most seasons, necessarily delay the planting and will force the farmer to plant mid-season and early varieties. Where

"Take-all" and similar diseases are troublesome, the varieties chosen should be planted as late as is permissible for each variety in accordance with the recommendations of the Department.

DI-CALCIUM PHOSPHATE—A NEW LOCALLY MANUFACTURED PHOSPHATE FOR STOCK LICKS.

The absence, or a deficiency, of any essential ingredient in their food, is likely to cause a depraved appetite in stock. Experience has shown that in this State a depraved appetite in cattle and sheep is almost invariably due to phosphorus deficiency. From the reports which have reached this Department, it is probable that no single disease in this State makes a greater toll upon productivity of our stock, or has a greater death roll, than that due directly and indirectly to an insufficient quantity of phosphorus in their food. In the case of dairy cattle, one of its outward signs is depraved appetite and consequent bone chewing, and it is responsible for losses due to Toxic paralysis or Botulism, formerly known as impaction or "dry bible," and also, in some cases, to sterility. With sheep, a very common visible sign is the eating of rabbit carcases or other debris due to the craving consequent upon the deficiency in the diet. The result of the deficiency is reduced wool productivity, general debility and frequently death. The death is often wrongly ascribed to eating the poison which the rabbits ate and which caused their death. This, however, is not so. The death of the cattle or sheep is indirectly the result of the phosphorus deficiency in the food the animals are receiving, combined with the presence of an organism, known as *B. botulinus*, found in the bones chewed or licked by the animals, and also in the rabbit carcases or other debris for which the animals have a craving. This craving is due to the phosphorus deficiency in the food, and when the animals satisfy it by eating the rabbit carcases, etc., they also ingest the organism and this sets up the trouble which in many cases results in death. Even though the Botulinus organism may not be present in the bones or debris and so cause death, the health of the animals is seriously affected by the deficiency of phosphorus and the productivity of the animal is reduced.

For hygienic reasons the carcases should be burnt or buried, and, for the general health of the stock, the phosphorus deficiency should be remedied and the depraved appetite and craving prevented. This can be done by providing, either in the feed or as a stock lick, some phosphatic compound such as ground rock phosphate, superphosphate, sterilised bone meal, basic superphosphate, etc. Though all these and others are suitable, they are not equally suitable. Their relative position is summed up by Sir Charles Martin, Chief of the Institute of Animal Nutrition, as follows:—

> It does not signify what form of phosphate is contained in the lick, provided that sufficient is absorbed into the animal system, and the other ingredients are not harmful. The amount absorbed depends, apart from the content—(1) on its availability, and (2) palatability.
>
> Availability is decided by the state of subdivision, solubility in digestive juices of varying hydrogen ion concentration, and some physiological factors not yet understood.
>
> The availability for cattle of a number of phosphatic materials has been roughly estimated by Theiler and Du Toit in South Africa by finding out the amount required to cure in two months the craving for bone-chewing in oxen, in which the habit was well established.
>
> * * * * * *
>
> As far as I can gather from the analysis of the records of their experiments, a daily dose of about 15 gms. (½ oz.) "Phosphoric acid" in the form of either orthophosphoric acid, di-sodium phosphate, di-calcium phosphate, commercial superphosphate, or bran was adequate. Of bone meal, 30 gms. (1 oz.) "Phosphoric acid" was necessary; of rock phosphate (probably Moroccan) 40 gms. (nearly 1½ ozs.) was insufficient, and South African rock phosphate from Saldhana Bay was of no use.
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> * * * * * *

However, when all is said and done, the readiness with which the animal will avail itself of the lick provided controls the situation. This can be determined by field experiments, but there is already a good deal of general experience to draw upon.

Experience gained at our field-stations at "Dismal Swamp," Kangaroo Island and "Meteor Downs" indicates that sheep consume bone meal and di-calcium phosphate mixed with salt readily in the dry season; ground Nauru phosphate less readily, but enough is eaten to supplement the diminished phosphorus in the herbage during the dry weather. Nauru phosphate was recommended by Brunnich and is now extensively used throughout Queensland with, I understand, satisfying results. At "Meteor Downs" it is consumed by our sheep in apparently sufficient amounts, little when the grass is green and a good deal when the paddocks are dry. It is cheaper than bone meal or di-calcium phosphate, but the greater content of "Phosphoric acid" and greater availability of the last mentioned more than compensates for the extra price. Super and glycerophosphate sheep appear to dislike, though they will eat them if hard put to obtain a supply of phosphorus.

From the above it will be seen how very desirable it is to have on the local market a phosphatic material of such high availability as di-calcium phosphate. In this connection it is interesting to record that, three years ago, in a short article "Phosphatic Licks for Stock," published in this Journal (December, 1928), the author, when referring to the need of a suitable phosphate for licks in Western Australia wrote—"It is believed that this will be supplied in the future by a specially prepared precipitated calcium phosphate." This belief has now been realised, and in response to the Departmental request the Cuming Smith-Mt. Lyell Fertiliser Co. are now manufacturing a high grade di-calcium phosphate suitable for use in the preparation of phosphatic stock licks, and are placing same on the market.*

In addition to its availability, another very distinct advantage of di-calcium phosphate is its high quality, containing as it does some 40 per cent. of "phosphoric acid." This will enable a very palatable lick, and, at the same time one of high grade quality, to be prepared, even when a comparatively large amount of salt is used. This has been a difficulty in the past as some of the phosphatic compounds, in order to be rendered palatable, require so much salt or other medicants to be mixed with them that the quantity of "phosphoric acid" is unduly low and, in consequence, some licks contain far too much salt in proportion to their content of "phosphoric acid." When this is the case animals, in an endeavour to satisfy the craving for phosphate, eat more salt than is good for them. In putting forward the Departmental formulae, A, B, and C,† this feature was kept in mind and the proportion of phosphate kept high at the expense, under some conditions, of its palatability. Despite this, however, the phosphoric acid content was not always sufficient to satisfy the requirements of the animal, as the following instance with stud weaners will show. The owner had mixed a lick in accordance with formula C, which contains twice as much phosphate as salt, and half of the phosphate was in the readily available form of di-calcic phosphate. To use the owner's words—"The young sheep did not lick the mixture, they ate it," but a later report stated that the depraved appetite was not cured, and so the amount of phosphate was doubled, with satisfactory results. The palatability of the lick, in this instance, was maintained by an increase in the amount of molasses.

Even if the new di-calcium phosphate be mixed with its own weight of salt, because of its greater availability and higher phosphatic content, it will be of much better quality than Formula C, which contains salt equivalent to only half the weight of the phosphate. It is also slightly more valuable than the double strength mixture referred to. In addition it will not have the disadvantage of carrying the considerable percentage of gypsum which is present in basic superphosphate, and which serves no useful purpose and must be regarded as a diluent.

* Since writing this article I have learnt that the Cresco Fertiliser Company has also placed a concentrated di-calcic phosphate stock lick upon the local market.

† "Phosphatic Licks for Stock"—Geo. L. Sutton, *Journ. Agric., W.A.*, Vol. 5 (2nd Series), Dec., 1928, p. 397.

Commercial di-calcic phosphate is a tasteless powder which mixes readily with salt. Experiments are now proceeding to determine the amount of salt necessary to add to it in order to make it palatable and acceptable to stock. It is in a very fine state of division and, for lick purposes, it will require to be mixed with a small amount of molasses to act as a binder and as an appetiser.

Compared with Bonemeal, which is a convenient standard for comparison, di-calcic concentrate is 50 per cent. richer in "phosphoric acid" and each unit of this may be regarded as twice as available or useful as a similar unit in Bonemeal.

THE JARVIS FRUIT FLY LURE—LOCAL TESTS—PROGRESS REPORT.

L. J. NEWMAN, Entomologist.

The Jarvis Fruit Fly Lure was first officially published in the Queensland Agricultural Journal, November, 1931. The claim was therein made that this lure was equally attractive to the Mediterranean Fruit Fly (*Ceratitis capitata*), as it had proved to be to the Queensland Fruit Fly (*Chartodacus tryoni*).

The lure is a combination of imitation vanilla essence, household ammonia, and water.

It is a fact that the various species of Trypetidae react to various odours or lures. This we demonstrated as far back as 1907, when we discovered that petroleum oil attracted the males of the Mediterranean Fruit Fly. This stimulated further research, resulting in the pollard, borax, and water lure, and more recently, the discovery that the proprietary preparation known as concentrated Clensel was even more attractive.

With the object of determining whether the Jarvis Lure was a more effective one than those now being used locally, a set of experimental tests was commenced on the 5th February. Two glass jar traps of a capacity of ½ pint each were used in separate fruit trees. The Jarvis Lure was placed against Clensel as a control. In each tree a jar of each lure was placed and suitably marked to avoid confusion.

The traps have their positions changed each week, thus ensuring an equal chance of capturing the flies. The lures are renewed every 7 days and the fly contents counted and sexes determined.

The Jarvis formula, as officially given, is strictly adhered to, namely, ⅛ oz. of imitation vanilla essence, ½ oz. household ammonia, 26 ozs. water. The Clensel control was used at the strength we always advise, 1 part to 30 parts water.

The progressive results to date have proved that the Jarvis Lure has but a very slight attraction for the Mediterranean Fruit Fly in this State.

In view of these results, local growers are advised to continue with either of the lures as now advocated by this Department.

The test is being continued, and when finalised the relative captures of flies and their sexes will be given in tabulated form.

PASTURE RENOVATION.

IRRIGATION AREA (OBSERVATIONAL).

C. GILES (Dairy Branch) and H. K. GIBSONE (Irrigation Branch).

For purposes of observation, and with the object of demonstrating the possibility of rapidly improving poor pastures, a paddock was selected with the following characteristics:—

(1) Need for drainage.
(2) Possibility for irrigation.
(3) Low fertility; little, if any, response to fertiliser having been noted the previous season, probably owing to lack of aeration.

The ground on which the experiment was carried out is a chocolate loam, the herbage in evidence prior to treatment being:—

(1) Couch Grass of a very poor quality (harsh and lacking vigour);
(2) Guildford Grass growing to a height of approximately 4 inches and brownish in colour;
(3) Subterranean Clover— a few stunted plants.

First Stage.

Ploughing was considered necessary in order to facilitate—

(1) drainage;
(2) irrigation; and
(3) the preparation of a suitable seed-bed.

This was carried out in October last year, to a depth of 5 inches with a single furrow mouldboard plough, and left open for a fortnight. No suitable implement was available for further operations, and the country was lying thoroughly open, due to its couch-bound condition. Hoof cultivation was decided upon as the most economical way out, and with this object in view Sudan Grass was seeded at the rate of 12 lb. per acre—Potato Manure No. 2, containing superphosphate and ammonia in the proportions five to one respectively was broadcast at the rate of 1 cwt. per acre and harrowed in. Germination was good but aftergrowth poor, sufficient, however, to achieve the object, as being fed off twice before the end of January, trampling from stock consolidated the open ploughed land.

Second Stage, commencing on 2nd February, 1931.

It was decided to make further observations, as Couch was plentiful and commencing to show more vigour. Water was applied on 2nd February. Fertiliser—Sulphate of Ammonia at the rate of 1 cwt. per acre versus Nitrate of Soda at rate of 1 cwt. per acre. No Superphosphate. This was broadcast and well harrowed in five days after watering, this period being necessary in order to obtain a mulch.

Superphosphate was not applied, it being assumed that sufficient phosphates were available, although this assumption was probably not justified, and a dressing is always recommended when any fertiisers are being applied.

Both fertilisers gave good results, the Couch responding rather more quickly to the Nitrate of Soda. Little variation, however, could be noted later.

For the remainder of the summer the treated area was grazed rotationally together with older fields. The healthy colour and vigorous growth of the treated area was outstanding in comparison with the distinctly yellow colour of the older areas suffering from lack of drainage.

March, 1931.

Drainage was now commenced with the object of overcoming future trouble from surface water. Labour was scarce and it was necessary to curtail the work as much as possible, and Mr. London arranged to cut drains to a depth of 18 inches by 12 inches wide only. This, however, proved effective, and by the middle of April (one watering only intervening), the colour of Couch over the whole area was now healthy.

Mineral Deposit. It should be noted here that, following the March application of water, by which time drainage was complete, a white mark approximately 1 inch wide was to be seen along the drain 5 inches below the surface level, indicating a very heavy mineral deposit, now probably lowered sufficiently to be no longer detrimental to pasture grasses. Previous to drainage this deposit had been on the surface.

May, 1931. With a view to obtaining winter grazing and a superior type of pasture, the following seeding was carried out early in May (after drastic harrowing):—

Perennial Rye Grass—7 lb. per acre.
Subterranean Clover—6 lb. per acre.

Germination was good but growth generally was unsatisfactory, probably owing to fertilisers being omitted when sowing these seeds, grasses in particular showing little inclination to make headway, it being necessary to search closely in order to observe them.

Intermittent grazing, however, was carried on until early September, when a further dressing of fertiliser was applied; this consisted of—

Superphosphate 2 parts + Sulphate of Ammonia 1 part over the major portion at the rate of 1 cwt. per acre, and

Superphosphate 4 parts + Sulphate of Ammonia 1 part over two lands running through the centre, with the object of ascertaining if possible whether phosphate or nitrogen was lacking.

Harrowing. The whole area was lightly harrowed with the Sunblade implement after fertiliser application and closed from stock for six weeks.

Results.

No. 1 dressing Superphosphate 2 parts, Sulphate of Ammonia 1 part, gave excellent results, both Grasses and Clovers responding rapidly.

No. 2. Superphosphate 4 parts, Sulphate of Ammonia 1 part, both grasses and clovers responding less rapidly, probably less than one-tenth edible fodder being available when pasture was thrown open for grazing.

The main head ditch for irrigating purposes was altered in direction, and by shortening the lateral irrigation channels it was found possible to irrigate the whole area thoroughly in half the time previously taken.

The 13 acres of irrigable flat were divided into four fields, and during the present summer have been grazed rotationally. The figures below will indicate the economic value of controlled grazing combined with irrigation:—

	1930.	1931.
Total butter fat produced	2,632	2,977
Butter fat per cow	188	212
Butter fat per acre	68.2	74.4
Average cost of feed per month ..	£8	10s.
Fertilisers applied	£12	£20
Tons of hay conserved	Nil	8 tons

The feed bill was therefore reduced £90 per annum, at an increased cost in fertilisers of £8.

The increased value of butter fat was £17 5s.

Summary.

It appears from these observations—

(1) That drainage is absolutely essential, neither summer nor winter growers giving satisfactory results prior to it.

(2) Hoof cultivation may be applied to advantage in order to create a sufficiently compact seed-bed for the inclusion of grasses.

(3) Little time need be lost so far as stocking is concerned, the carrying capacity having been considerably increased over the whole period.

(4) That the farmer should take steps to discover by experiment the weakest link in the chain of nutritive substances in his land, as weakness in any one link cannot be compensated for by strengthening others.

If, as in this instance, the natural supplies of nitrogen are deficient, no improvement in the crop can take place by additional supplies of phosphoric acid or potash. This also applies to other essential conditions of growth, soil temperature, aeration, etc. If one or the other is unsatisfactory, then again growth will be limited or non-existent.

WHEAT SEEDING.

THE CORRECT DEPTH TO PLANT.

I. THOMAS, Superintendent of Wheat Farms, and H. A. PITTMAN, Plant Pathologist.

A number of inquiries have recently been received from wheat farmers as to the correct depth to sow the grain.

In this connection the wheat seedling itself provides us with the best answer to the question *re* the proper depth of seeding, inasmuch as no matter how deeply the seed is sown, provided it is able to germinate and develop normally, it will always form its permanent root system at about 1½ inches below the surface of the soil. The primary or seedling root system which forms at the time of germination normally dies away very early in the growth of the wheat plant.

If one carefully digs up well-developed wheat seedlings, when the seeds have been planted, say, 2½ inches to 3 inches deep, one will find that there is an inch or so of thin seedling stem above the seed, and between the seed and the point where the permanent root system is being formed. The deeper the seed is planted the longer is this seedling stem segment.

On the other hand, if the seed is planted about 1½ inches below the surface of the soil, the permanent root system will develop at about the same level as the seedling root system. This means that the time and energy which would otherwise be wasted in the development of the seedling wheat plant is conserved, and a more vigorous and healthy plant results, other things being equal, than if the wheat had been planted deeper in the soil. Further, with deep planting there is always a danger of a hard crust forming on the surface

of the soil before the young seedling can break through, with the result that a considerable number of seedlings may die. This failure is often attributed to malting.

Deep planting often indicates an improperly-prepared and improperly-consolidated seed bed.

It has been found that the deeper the seed is planted the greater is the percentage of "bunt" and "flag smut" in the crop, owing to the fact that infection with these diseases takes place during the germination of the seed; the possibility of infection ceasing with the breaking of the first leaf through its little white sheath (*coleoptile*). "Take-all," "Root-rot," and "Foot-rot" are also made more serious through deep seeding, and there is some indication that the same thing applies to frost injury of wheat stems in the spring.

As indicated above, then, the proper depth to plant wheat under normal conditions, is about $1\frac{1}{2}$ inches to 2 inches below the surface of the soil an ideal mulch at seeding time being about that depth. Should the mulch, however, for any reason, be very much deeper, it might be desirable to sow deeper when planting early in the season. The reason for this is that light rains falling before the general winter rains may germinate the seed, but may not be sufficient to maintain it for any length of time if planted closer to the surface.

PRODUCERS' MARKETS CO-OPERATIVE, LIMITED.

QUARTERLY REPORT.

Fruit: Heavy fruit supplies forward for December sales to a good demand for prime fruit. Stone fruit of prime and large grade sold to a steady demand. Peaches were short throughout, the quarter selling at high values. Valencia oranges and lemons were in keen demand throughout. New season apples of good quality maintained their prices, but with the increased supplies of cooking varieties, values eased, only large sizes being in demand. With the exception of a few sales, nectarines were also short-supplied and in keen demand.

Tomato values at the December sales were satisfactory, but with the heavy supplies forward the market became over-supplied at the latter part of the period under review and values slumped, the factory taking the bulk of supplies.

Bartlett pears were also marketed during the end of this period with values firm for good and clean fruit.

Vegetables: Steady supplies forward. Potatoes from the metropolitan area are practically finished. The crop generally was lighter than usual, but values were better than for some years. Pumpkins were marketed early in the season and values were firm, but during the last month supplies increased and immature lines caused prices to recede. Swedes of good quality were very short, and a good demand exists. Cabbage was fairly plentiful early in the period, but supplies are now on the short side with firm values. Beans were fairly plentiful, but growers experienced a better season this year than last. Peas also were a much better value. Water-melons were plentiful this year, but the

majority of the crop show the signs of the dry weather and are very small. There is a brisk demand for all large lines. Rock-melons were also plentiful and values steady. Onions: The crop was lighter this year and values are firmer in consequence, prices at the moment being very high. Rhubarb was in steady demand all through. Celery of good quality is short, but inferior lines plentiful. Bunch lines heavily supplied, and the demand generally weak. Lettuce in good demand.

Eggs: During the quarter under review, egg supplies were maintained from 13th November to 2nd December with values fluctuating in accordance with the supply and demand, and ranging from 9d. to 11d. for metropolitan new laid hen and standard; 8½d. to 9½d. country new laid, and 7½d. to 8½d. country stores. After 4th December a number of clients ceased export operations, with the result that supplies increased and were greater than the demand with a corresponding decrease in values, metropolitan new laid hen and standard realising from 6½d. to 10½d.; country new laid 6d. to 8½d., and country stores 5½d. to 7½d. We take this opportunity of pointing out that about this time supplies from the country had increased, and were hard to quit at satisfactory prices owing to a number of cases consigned from long distances arriving in a bad condition owing to the excessive heat. On 19th December export operations ceased with larger quantities coming on to the local floor, however, the Christmas trade helped to firm the market temporarily, metropolitan hen and standard selling at 8d. to 10½d., country new laid 7d. to 8d., and country stores 6d. to 6½d. With Christmas over, supplies were still heavy with prices easier throughout, but at this time the local floor was again relieved by a number of growers cool storing large quantities and an agent pulping, this had the effect of making the demand equal to the supply and prices rose accordingly, metropolitan new laid hen and standard 10½d. to 1s. 3½d.: country new laid 6d. to 1s.; country stores 5½d. to 7d.

At the end of January cool storing was finished with the floors becoming heavily supplied, and prices showing a tendency to ease on all metropolitan lines. At present egg values are weak, and with a large number of eggs in cool storage it is a difficult proposition to forecast the tone of the egg market in the near future.

Poultry: During the quarter under review poultry supplies were heavy from November up to Christmas, with good prices offering for all prime lines. Aged and half-grown birds were hard to quit at satisfactory values. Prime cockerels realised up to 10s., with the average ranging from 7s. 6d. to 9s.; prime hens to 7s. 3d., wtih an average of from 5s. to 6s.; prime muscovy drakes to 15s. 6d., average 9s. to 13s. 6d.; prime muscovy ducks to 9s. 9d., average 6s. to 7s. 6d. Prime turkey gobblers to 43s., average 18s. to 30s.; prime turkey hens to 20s., average 11s. to 15s. The highest prices realised were about Christmas time, when a considerable improvement was shown in the quality of the birds submitted for sale.

Since Christmas supplies have been moderate, with good values for prime cockerels. Muscovy ducks and drakes have been heavily supplied, with low values offering. There have been no turkey hens or gobblers offering. Aged and half-grown birds have realised low values, and are hard to quit.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, & Co., Limited, Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS.

FOR MONTHS OF DECEMBER, 1931, JANUARY AND FEBRUARY, 1932.

	December.				January.					February.		
—	2.	9	16	22.	6.	13.	20.	27.	3	10.	17.	24.
Sheep	10,093	8,556	15,144	10,215	11.857	12,253	13,668	11,088	7,558	9,773	10,585	8,930
Cattle	534	464	387	394	558	519	545	603	476	539	665	656
Pigs	1,047	1,058	2.403	998	1.829	1,819	1,739	1,828	1,450	1,327	1,392	1,563

COMPARATIVE VALUES PER POUND.

Mutton	3d.	3½d.	3¼d.	3¼d.	3¾d.	3¾d.	3¼d.	2¾d.	3d.	3¼d.	3d.	3½d.
Beef	3¾d.	3¾d.	4d.	4¼d.	5d.	5d.	4¾d.	4d.	4½d.	4¾d.	4½d.	4¼d.
Pork	5½d.	6½d.	6¾d.	6¾d.	6½d.	6½d.	6½d.	6½d.	6½d.	6½d.	6½d.	6½d.
Bacon	5¼d.	5½d.	5½d.	5½d	5½d	5½d.	5½d.	5½d.	5¼d.	5½d.	5½d.	5½d.

MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding chaff offered at auction in the Perth Railway Yards for the period December to February (inclusive). In all cases the prices quoted are for f.a.q. to prime wheaten chaff, packed in new bags:—

	Maximum.	Minimum.
	£ s. d.	£ s. d.
December, 1931	3 10 0	3 7 6
January, 1932	3 12 6	3 10 0
February, 1932	4 10 0	4 5 0

Fair supplies of f.a.q. to prime wheaten chaff arrived during the months of December and January, but we are very pleased to report that towards the end of January the value firmed considerably, and in several instances f.a.q. to prime wheaten chaff sold at £4 per ton. During February short supplies were experienced, and the market advanced still further to £4 10s. per ton. We are pleased to advise that at the time of writing the market remains at around this figure, and in some instances consignments have sold at from £4 12s. 6d. to £4 15s. per ton.

Oaten Chaff.—In December prime green quality sold at £3 10s., and f.a.q. found buyers at £3 7s. 6d. per ton. During January several consignments of prime quality made £3 12s. 6d., and f.a.q. £3 10s. per ton. In February few consignments of prime quality arrived, and there was a good inquiry for same at £4 10s., and for f.a.q. at £4 5s. per ton. We are pleased to advise that, at the time of writing, consignments are still selling at these figures.

Oats.—Throughout the period under review the market remained firm, the quotations being as under:—

December, January and February.

Good heavy feed, Guyras and Mulgas	2s. to 2s. 3d. per bushel.
Good feeds	1s. 9d. to 1s. 10d. per bushel.

Wheat.—During December f.a.q. sold at 3s. 4d. per bushel, and second grade at from 3s. 1d. to 3s. 1½d., quality slightly affected with smut realised from 2s. 6d. to 2s. 9d. per bushel. In January heavy consignments came forward and the market eased slightly, f.a.q. made 3s. 3d., second grade 3s., quality slightly affected with smut realised from 2s. 9d. to 2s. 10d. per bushel. During February we are pleased to advise that the price of f.a.q. wheat advanced to 3s. 3d. per bushel, second grade changed hands at from 3s. 2d. to 3s. 3d., samples containing smut ball sold at 3s. 2½d., consignments affected with smut sold at 2s. to 3s. 1½d. per bushel.

METEOROLOGICAL INFORMATION.

Stations.	Temperature.				Rainfall.		Temperature.				Rainfall.		Temperature.				Rainfall.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	December, 1931.						January, 1932.						February, 1932.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	95·3	107·3	63·9	54·0	0·56	0·22	95·0	111·7	67·7	58·1	1·18	0·27	95·3	108·3	66·8	57·2	0·00	0·48
Geraldton	88·7	107·6	66·6	57·6	0·47	0·16	85·0	102·0	70·0	59·8	0·44	0·22	87·9	108·8	69·0	59·0	0·00	0·30
Walebing	94·4	108·0	63·3	47·1	0·59	0·48	97·1	109·5	66·4	53·3	0·21	0·35	94·6	106·0	62·4	50·2	0·00	0·52
Perth	89·1	101·2	66·6	55·5	0·37	0·58	88·4	106·4	67·5	57·7	0·19	0·34	88·0	102·0	65·5	55·0	0·00	0·42
Kalamunda	88·7	100·4	63·1	52·9	0·77	0·81	89·4	103·0	64·7	56·1	0·25	0·55	89·2	101·9	62·4	51·2	0·00	0·67
Bunbury	83·1	93·0	60·6	49·0	0·40	0·58	83·0	100·0	61·9	48 0	0·37	0·43	82·6	91·0	60·5	49·0	0·05	0·55
Bridgetown	91·9	105·5	53·9	39·0	1·36	0·77	89·4	108·0	55·8	44·8	1·60	0·54	90·0	103·0	54·5	42·2	0·11	0·65
Albany	73·8	92·0	58·9	50·0	2·83	1·16	74 6	86·0	60·8	53·0	1·31	0·84	74·4	100·1	60·6	54·0	0·51	0·94
Merredin State Farm	92·4	104·9	63·1	51·5	0·40	1·54	95·7	108·1	67·3	55·2	0·51	0·52	92·6	105·9	62·4	50·9	0·11	0·56
Northam	93·9	105·0	63·5	52·0	0·28	1·35	96·5	108·0	67·9	56·0	0·09	0·28	94·3	106·8	63·2	54·8	0·00	0·38
York	92·6	104·5	61·5	51·0	0·77	1·41	94·6	106·0	66·2	55·5	0·05	0·31	92·6	105·5	61·3	54·0	0·00	0·45
Narrogin State Farm	89·7	101·0	56·5	48·0	0·31	1·58	90·8	105·0	60·1	50·4	0·65	0·32	87·9	100·3	55·4	42·2	0·00	0·58
Katanning	89·6	102·3	56·2	47·1	1·31	1·62	88·6	104·6	59·4	50·8	0·55	0·37	86·7	103·0	56·8	47·3	0·06	0·57
Cape Leeuwin ...	74·8	92·8	63·4	56·4	0·44	1·86	74·1	81·0	64·7	61·0	0·20	0·67	76·7	94·0	64·5	58·0	0·21	0·85

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

No. 20.—*The Pruning of Fruit Trees.* J. F. Moody. Price 2s. 6d.
No. 24.—*Hints to Stock Breeders* (revised). R. E. Weir.
No. 37.—*Conference of Producers,* 1910 *and* 1912.
No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
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No. 74.—*Tobacco Cultivation.* A. R. C. Clifton.
No. 79.—*Sheep on the Wheat Farm and their Management in W.A.* H. McCallum.
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No. 96.—*Poison Plants of W.A.* D. A. Herbert.
No. 99.—*Australian White.* G. L. Sutton.
No. 101.—*Cotton Cultivation.* G. L. Sutton.
No. 103.—*Kerosene Method for Eradicating Zamia Palm.* G. K. Baron-Hay.
No. 105.—*Pedigree Selection of Seed.* G. L. Sutton.
No. 106.—*The Red Legged Velvet Earth Mite.* L. J. Newman.
No. 112.—*Automatic Device for Eradication of Stickfast Flea.* G. Allman.
No. 113.—*Picked Pieces: Classification of Clip.*
No. 114.—*Blue Mould on Citrus Fruits.* W. M. Carne.
No. 115.—*The Value of Windmills for Pumping Water in W.A.* A. H. Scott.
No. 117.—*Cream.* P. G. Hampshire.
No. 149.—*Lucerne.* G. L. Sutton.
No. 192.—*Root Rot.* A. J. Despeissis.
No. 220.—*Irrigation and Drainage.* A. H. Scott.
No. 221.—*Soudan Grass.* G. L. Sutton.
No. 225.—*Subterranean Clover.* G. K. Baron-Hay.
No. 238.—*The first Australian Studmaster—His Flock.* G. L. Sutton. (Reprint from "Journal.")
No. 239.—*Field Experiments, Chapman* I. Thomas (Reprint from "Journal.")
No. 241.—*Field Experiments, Merredin.* Langfield (Reprint from "Journal.")
No. 242.—*Field Experiments, Avondale.* Wild and Bailey. (Reprint from "Journal.")
No. 243.—*Successful Codlin Moth Control in W A.* G. W. Wickens. (Reprint from "Journal.")
No. 245.—*Leaf Rust of Stone Fruit.* W. M. Carne. (Reprint from "Journal.")
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No. 250.—*Sheep—Hand-feeding.* H. McCallum. (Reprint from "Journal.")
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No. 273.—*Subterranean Clover Seed and its Impurities, with a Comparison between Machine-Cleaned Seed and Seed in the Burr.* H. G. Elliott. (Reprint from "Journal.")
No. 274.—*Nut Grass.* C. A. Gardner. (Reprint from "Journal.")
No. 276.—*Minerals in Pastures and their relation to Animal Nutrition.* J. B. Orr. Reprinted from "Journal.")
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No. 278.—*Pear Scab.* G. W. Wickens. (Reprint from "Journal.")
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No. 288.—*Pastures. In Areas of Medium Rainfall.* G. K. Baron-Hay, Assistant Superintendent of Dairying.
No. 289.—*The Unsound Economics of the F.A.Q. Standard for Selling Australian Wheat.* Geo. L. Sutton.
No. 290.—*Wax Scale (Ceroplastes Ceriferus),* Anderson. L. J. Newman, F.E.S., Entomologist; B. A. O'Connor, B.Sc. Agr., Agricultural Adviser; and H. G. Andrewartha, B.Sc.Agr., Agricultural Adviser.
No. 291.—"*Early Blight*" *or* "*Leaf Spot*" *and the Macrosporium* "*Storage Disease*" *of Potatoes.* H. A. Pittman, B.Sc.Agr., Plant Pathologist.
No. 292.—*Cultivation of Onions.* E. T. Morgan, Vegetable Inspector.
No. 294.—*Best Kept Farm Competition—Manjimup.* M. Cullity.
No. 298.—*Seed Testing—Value of.* H. G. Elliott
No. 299.—*Blowfly Parasite.* C. Newman and H. G. Andrewartha.
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No. 317.—*Blowflies in South-West—Seasonal Influence.* Newman, O'Connor and Andrewartha.
No. 318.—*Bees Act.* Willoughby Lance
No. 319.—*Cape Gooseberry.* G. W. Wickens.
No. 320.—*Agricultural Seeds and Their Weed Impurities.* H. G. Elliott.
No. 321.—*Cooling of Milk and Cream.* G. K. Baron-Hay.
No. 322.—*Feeding Wheat to Pigs.* G. K. Baron-Hay.
No. 324.—*Seed Testing for Farmers. etc.* H. A. Pittman.
No. 325.—*Apple Curculio.* H. G. Andrewartha.
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No. 331.—*Carniolan Bees.* H. Willoughby Lance.
No. 332.—*Cool Dairies for Cream.* M. Cullity.
No. 333.—*The Centrifugal Cream.* G. K. Baron-Hay.
No. 334.—*Sugar Beet and Its Cultivation.* G. L. Sutton.
No. 336.—*Seed and Seed-Bed Disinfection.* H. A. Pittman.

The following publications may be obtained from the Department of Agriculture, Perth, on application, or will be sent post free to any address in this State on receipt of a remittance for the amount stated:—

The Management of Poultry under Western Australian Conditions, by W. T. Richardson Poultry Adviser.

This is a most useful and valuable book, not only for beginners, but to all those who keep fowls for pleasure and profit. It deals fully with all matters connected with the industry, including Breeding, Feeding (for stock birds or egg production), Incubating, Brooding and Care of Chicks, Marketing (eggs and poultry), and all matters of use to the poultry-keeper. It also fully describes symptoms of various ailments and diseases and simple treatment for same, and, as the book was written to suit *local conditions*, every poultry-keeper should have a copy by him. Price, 2s.

The Pruning of Fruit Trees, by J. F. Moody, Fruit Industries Commissioner:

This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

Fruit Packing and the Marketing and Exporting of Fruit, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

JOURNAL

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WESTERN AUSTRALIA.

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THE HISTORY OF THE WOOL INDUSTRY IN WESTERN AUSTRALIA.

Being a broadcast by H. McCallum, Sheep and Wool Inspector, during Wool Week.

Wool—what a series of pictures this one short word can call to mind—(from the early settlement days until the present with its well-established farms and stations)—and what hardships and perils have been faced to lay a strong foundation for this very important industry in Western Australia.

Like every other industry, it has had its pioneering days, and the pastoralists, since the founding of the State, have ever been in the van of progress.

In the year 1829, over 1,000 sheep were brought to the Swan River Settlement, and were pastured near the Darling Ranges. Yearly other flocks were imported, and as early as 1832 a parcel of wool was shipped to London and realised 2s. 2d. per lb.

With the growth of the settlement the sheep-owners looked farther afield and travelled their flocks inland to the then wilderness in the possession of hostile blacks—the Toodyay-York district. Ever spreading, sheep owners then settled in the Geraldton and Irwin areas, and in 1834 sheep were pastured in the areas around Albany. In 1837 further sheep were imported for the southern parts of the State. Within ten years of the first settlement the wool-growing industry was more or less established, and through the years it has continued to develop.

The adventurous settlers gradually paved the way by exploring new areas, and by 1842 there were 60,000 sheep in the State, pastured from the districts northwards of Geraldton to the southern coast. At this time the weight of wool cut per sheep was very light, good clips averaging from 3½ to 4 lbs.

For the next twenty-five years wool-growing was practically confined to the same area—the South-Western Division of the State, and in 1861 the number of sheep totalled less than half a million.

Then reports from hardy explorers, who had pressed northwards and found new well-grassed areas, fired the imagination of a few enterprising colonists, and two years later they landed at Cossack with a few hundred sheep. This landing opened the first chapter in the volume of the conquest of the North, with its vast rich areas. These settlers held on and, though without the comforts of civilisation, daily in conflict with nature and treacherous blacks, with failure and disappointment threatening them often, successfully established their holdings.

Later expeditions into the interior brought forth the information that good sheep country abounded and flocks extended into the Upper Gascoyne, Murchison, Ashburton, and Kimberley districts. These big open spaces of the north soon became the chief home of the Merino.

With the number of holdings increasing annually, large numbers of high class sheep were imported, and special attention started to be given to improving the quality of the wool and endeavouring to increase the quantity.

By 1890 the number of sheep pastured had risen to $2\frac{1}{2}$ millions, with a total wool clip of 9 million pounds weight, and 166 million acres were held under pastoral lease.

Whilst wool-growing had made amazing progress in the pastoral areas, it had been just steadily continuing in the South-Western Division, and it was not until the development of the wheat and mixed farming activities that it received an impetus in this area. As farming progressed, so the flocks increased and extended into new districts.

In 1910 the flocks totalled over 5 millions and the poundage of wool produced 26 millions.

Practically the whole of the wool produced in the State was exported prior to the year 1912, when great enthusiasm was created over an offering of 540 bales.

A movement of great importance during 1916-17 was the British Imperial Government Wool Scheme brought about by the war. All the wool grown in the State was received into stores at Fremantle, Albany, and Geraldton, where it was appraised under the jurisdiction of the Central Wool Committee on behalf of the Commonwealth Government. During the appraisements thousands of wool growers visited the wool stores to inspect the clips, and gained an education which was of inestimable value. This scheme operated for four years, and when it was terminated wool selling by auction was instituted. The opening sale under the new method was held in December, 1920.

Each season showed an increase in the quantity of wool submitted for sale, and soon the warehouse space was taxed to its utmost. The brokers then found it necessary to provide additional space, and the present commodious stores were erected for the accommodation and display of clips. These stores are modern, and the latest methods of receiving and displaying the wool have been adopted, with the result that they compare favourably with any stores throughout the Commonwealth.

Although progress in wool-growing is reported each year, it cannot be expected to make a uniform advance, as much depends on the seasons. 1927 was especially favourable and witnessed a wonderful expansion, the number of sheep increased by a million, and the clip by over 9 million pounds, and the average weight of fleece cut per sheep from 6.8 to 7.1 lbs.

Early in the present century stud-breeding of merino sheep was commenced in this State, as it was realised that large amounts of money were being sent out of the State annually in the purchase of flock rams. This innovation has proved a great success, and, in addition to keeping capital within the State, has two great advantages—the purchaser can inspect and personally select animals to meet the requirements of his flock, and the animals, being used to local conditions, do not suffer any setback through requiring to become acclimatised. At the present time all flock and general farming ram requirements can be met from the existing studs, where they have been bred from importations from the leading breeders in the Eastern States.

During the past fifteen years the industry has been greatly developed in the pastoral country to the northward of Kalgoorlie. Thousands of the best sheep were imported from the other States and these holdings stocked up, the wools from this district now making quite a large entry on the sale catalogue.

By the careful selection and breeding of sheep the average weight per head of wool cut has been increased, and in these days, when attention is being paid to the improvement of pastures by the use of superphosphates and the sowing of suitable fodders, we cannot estimate the future carrying capacity of the holdings within the State.

There are three areas from which wool is obtained:—the North-West and North; the Great Southern and South-West; and the Wheat Belt. Each wool is of a distinct type; that from the pastoral areas is much sought by Continental buyers, whilst Yorkshire shows a preference for that from the Southern and Agricultural areas.

The total production of wool for the 1930-31 season was 71½ million pounds, which is 4½ million pounds greater than the previous year. The total number of sheep pastured is about 10 million.

Closely connected with the wool industry is the breeding of lambs for market and the export trade, and this avenue of producing revenue is being rapidly explored. Last season 65,000 lambs were exported, and a great increase is expected. We have every advantage for engaging in this trade and should make a success of it. Our climate and also geographical position should enable our lambs to be on the English market ahead of any others in the Commonwealth.

There are about 9,000 wool-growers in the State, and these with their families total some 40,000 persons directly dependent on wool-production. There are thousands of other people, though not direct producers, who rely on wool for their employment. When wool prices are high, the whole community shares in the benefits therefrom, and, similarly, falling prices cast a shadow on all. It therefore behoves us all to do our best to promote wool sales; we should become "wool conscious" and select clothing made from good West Australian wool manufactured at the Albany mills. Make "wool week" unite us in the use of more wool and so promote prosperity in our midst. When the producer can say "all's well" then "all's well" with the West.

And in conclusion, a tribute to the pioneers of our State is due. We to-day are reaping the benefits of their enterprise, courage and patient endurance, and history records no higher heroisms than those of the brave men and women who penetrated into the unknown of a new land to lay the foundation of what is to-day one of our State's main industries.

"CLASSING THE CLIP."

C. E. COWLEY.

I have read with interest this publication and consider it is very instructive on the handling of the wool from the sheep to the factory. All branches of the work are dealt with in a very clear manner and expressed in simple language, making it easy for the very beginner to grasp the procedures outlined and the objects at which to aim.

From the point of view of wool growers in this State, however, there are two minor points which may be a little misleading.

The use of the word "Canary" to indicate the depth of yellow in "yolk stained" wool (page 44).

"Canary" stained wool as known in Western Australia cannot yet be said to be due to the presence of an over-abundant supply of yolk. To date the cause of this stain in wools from the Northern pastoral areas of Western Australia has baffled scientists, and is still being investigated. "Canary" stain, even in the very slightest tinge, cannot be scoured out of the wool, whereas "yolk" stain, unless exceptionally deep and bright, will yield to scouring.

Classing.—The formation of lines does not coincide with those advocated in this State.

The Western Australian top lines are usually marked Super, A.A.A., A.A., A., whereas the lines suggested in Mr. Cowley's book are marked Super, 1st, Second, "A."

HUGH McCALLUM,
Sheep and Wool Inspector.

10th July, 1931.

SUMMER FODDER CROP COMPETITION.

C. GILES, Dairy Instructor.

In order to encourage the growing of summer fodders, the Royal Agricultural Society offered prizes for the best crops of summer growing plants in each of three Zones into which the State was divided. In addition a Special Prize of £5 was to have been awarded to the competitor producing the highest yield per acre in any Zone irrespective of other points.

The following shows the boundaries of the three Zones:—

Zone 1.—Country north of a line running from the coast due east through Dardanup to the Great Southern Railway Line.

Zone 2.—A line from the southern boundary of Zone 1 due south through Boyup Brook to the coast. All country west of this line and bounded by the coast to be in Zone 2.

Zone 3.—Districts south of Zone 1 and east of the eastern boundary of Zone 2 embracing the Denmark district.

The summer proved an exceedingly long one, and very little rain fell throughout the whole of the South-West during this period. Moreover, the cultivation

of fodder crops did not receive the attention warranted, with the result that not only were very few entries received but that the cream supplies from many farms, and indeed districts, fell considerably as compared with previous years through the lack of green fodder for cattle.

Only three entries were received in Zone 1 and finally judged as, owing to the unfavourable season, fodder crops generally have not been a success. The three entries judged, however, were all good crops, though not up to the standard of previous years.

The following points were allotted:—

A. W. Gibbings, Coolup—96 points.

H. Hardy, Cookernup—90 points.

L. Pearson, Benger—83 points.

The detailed points were allotted as follow:

—	A. W. Gibbings, Coolup.	H. Hardy, Cookernup.	L. Pearson, Benger.	Total points allowed.
Yield based on feed value per acre	50	42	40	50
Freedom from weeds	15	15	15	15
Cultivation	12	15	12	15
Freedom from Disease	10	9	8	10
Evenness of growth	9	9	8	10
	96	90	83	100

Winning Crop of Maize. A. W. Gibbings, Coolup.
Yield 14.34 tons per acre.

Rainfall.—The average annual rainfall for Brunswick Junction, the nearest station, taken over the last 33 years, was 41.54 inches. The rainfall which occurred during the growing period (November to February) was 101 points, the monthy precipitation being as follows, the season, therefore, being an unusually dry one:—

November	19 points.
December	44 „
January	38 „
February	Nil
Total	101 points.

The following are particulars regarding the method of cultivation:—

——	A. W. Gibbings.	H. Hardy.	L. Pearson.
Weights taken	Feb. 10th ...	Feb. 15th ...	Feb. 4th
Drills apart	30in.	36in.	27in.
Average height	9ft. to 10ft. ...	7ft. 6in. ...	5ft.
Fertiliser—rate per acre ...	Super. 3 cwt. ...	Super plus Sulph. Ammonia, mix. 3 to 1, 3 cwt.	Super. and Ammonia. No. 2—3 cwt. p.a.
Soil	Black swamp ...	Sand and clay loam	Clay to sandy
Date of Seeding	December ...	Nov. to Jan. ...	Mid-December
Approx. Germination per cent.	95 per cent. ...	80 per cent. ...	70 per cent.
Estimated Weight per acre (tons)	14·34	10·71	9·6

PASTURE EXPERIMENT PLOTS—DENMARK STUD FARM.

G. K. Baron-Hay, Superintendent of Dairying, and
G. E. Elliott, Agricultural Adviser.

With the object of proving and testing varieties of pasture and fodder plants which may be suitable for the extreme South-West portion of the State, experimental and trial plots have been inaugurated at the Denmark Stud Farm. Various species were planted with a view to demonstrating their—

(a) persistency;

(b) habits of growth;

(c) suitability for pasture or fodder in that district.

The State Stud Farm is situated close to the Denmark township, about 250 miles in a southerly direction from Perth. The surrounding country is hilly, but on the farm the ground is more or less even with gentle slopes.

The plots are situated on land which was originally heavily timbered with karri (*E. diversicolor*). The soil is a medium loam with small outcrops of granite, the surface having a tendency to set when dry. Drainage into the Denmark River is good, and the soil—if cultivated—is retentive of moisture during the summer.

The rainfall for the season April, 1931, to March, 1932, and the mean annual rainfall for 1931, are shown in the following table:—

Month.	1931.	Mean Annual Rainfall.
	inches.	inches.
April	4·39	3·48
May	6·19	5·88
June	6·12	6·93
July	9·05	7·62
August	7·18	6·56
September	7·22	5·38
October	2·38	4·47
November	0·61	1·87
December	2·56	1·45
	1932.	
January	0·56	1·12
February	0·95	1·49
March	1·10	2·27
Total	48·31	48·52

The above table shows that the average annual rainfall for Denmark is 48.52 inches, and that the major portion of the rain falls in the winter months, with a relatively moderate precipitation during the summer. The fall for the summer just passed was 334 points below average, and for the five months October to February the rainfall registered was only 706 points.

The following gives a brief outline of the cultural methods and the observations noted from the time of planting and up to May of this year:—

Cultivation.—The land was well worked to make a fine even tilth for the seed bed.

Seeding.—The different varieties of seeds were planted in ½-chain rows with 3 links between each variety.

Rate of Seeding.—⅛ ounce of seed was sown per row and lightly covered, equalling approximately 20 lbs. per acre.

Fertiliser.—2 cwts. of superphosphate and ½ cwt. of sulphate of ammonia per acre were applied before seeding.

LEGUMES.

Lucerne (*Medicago sativa*).—On 5th June, 20 different strains were planted, but owing to the ravages of the lucerne flea and red mite it was necessary to resow three times. The last sowing was carried out on the 9th October and a good germination resulted. Six weeks later it was evident that the "Hunter River," "Spanish," and "Mudgee" varieties were making the most headway.

From that time until the end of February all rows were cut twice, and the result showed that the "Hunter River" was still the most outstanding strain, with "Mudgee," "Tamworth," "Poitore," "Province," "Montana," "Dakota," and "Kansas" thriving well.

In May it was noticed that the lucerne flea was present and doing considerable damage.

The "Hunter River" was still ahead of the others, but was closely followed by the "South African," "Peruvian," "Marlborough," "English," "North Californian," "Poitore," "Spanish," "Mudgee," and "Tamworth" in that order.

The above indicates that of the 20 strains planted the "Hunter River" is the best, being the first to come away and following up by producing the best bulk, being closely followed by the "Mudgee" early in the summer and the "South African" later towards the autumn.

The "Chinese" and "Mongolian" strains are distinct in habit from the rest, being more prostrate, having smaller foliage, shorter growth, and producing the least bulk.

These results with lucerne, which are corroborated in other areas, point to the very difficult establishment of lucerne when planted in autumn. *It would seem that spring planting is essential.*

Red Clover (Trifolium pratense perenne).—Of the 10 strains planted on the 6th June, it was noticeable from the time they germinated that all were practically untouched by the lucerne flea and only slightly affected by the red mite. In the earlier stages of growth it was soon noticed, however, that the "English Late Flowering" and the "American Mammoth" were the most prominent and making the best growth and bulk.

An the end of February the "American Mammoth," "English Late Flowering," and the "Montgomery Red" were giving the best results, and in May these three were superseded by the "Italian" strain. The "Late Flowering Cornish Marl" was the only one which failed owing to bad germination.

With the Red Clovers, the results indicate that the "American Mammoth" and the "English Late Flowering" are the most outstanding, and all strains were only slightly attacked by the lucerne flea and red mite.

The very valuable observations during the past season *that the Red Clovers are comparatively resistent to lucerne flea* indicate an important place this variety of clover may have in farming practice, where the ravages of the lucerne flea are serious.

White Clover (Trifolium repens).—On 9th June nine rows were planted with White clover. Of these, six were Wild White Clovers of English and New Zealand origin. From the time of germination, all rows suffered very severely from attacks of the lucerne flea and red mite, but not severely enough to necessitate resowing.

The early growth of these clovers was poor, but from November onwards they made rapid progress. It was then evident that the "Dutch," "Giant English," and "Lodi Mammoth" had larger foliage, produced more bulk and uneven growth than the Wild White Clovers, which were prostrate in habit, having smaller foliage, growing slower and more persistent. It was evident in May that the "White Dutch" and "Giant English" were the best bulk producers. Of the "Wild White" varieties, the New Zealand strain was the best, being closely followed by the "Kentish" old pasture.

From the first season's results, it appears that to obtain a good bulk the first year the White Clovers are superior to the Wild White Clovers, but for evenness of growth and persistency the New Zealand "Wild White" is the most outstanding, and would not be damaged to the same extent by grazing as the White Dutch Clover.

MISCELLANEOUS LEGUMES.

Subterranean Clover (Trifolium subterraneum).—An annual which produced an excellent stand, but was very severely attacked by the lucerne flea and red mite in the earlier stages.

Lotus corniculatus.—The germination of this trefoil was only fair, and no real headway was made until after November.

This variety of *Lotus proved very resistant to attacks from the lucerne flea and red mite,* and for this reason may prove most important in pasture mixtures, in addition to which this plant proved very persistent.

Sulla (Hedysarium coronarium).—The germination and subsequent growth of this plant was poor. Lack of the proper nitrogen-fixing bacteria may account for the poorness in growth.

GRASSES

Rye Grasses (Lolium spp.).—Four rows containing three perennial and one Italian strain were planted on 16th June. Germination in all rows was exceptionally good.

Early observations indicated that the Italian Rye Grass was making the best growth, but later on towards the summer the perennials produced equally as large a bulk of herbage.

Portions of the rows were subjected to continual cutting, with the result that exceptional growth was obtained in the cut portions of all rows.

In April it was noticed *that the Italian Rye Grass was not making the same recovery as the perennials,* and that it was practically impossible to distinguish the difference in growth and habit of the three perennials, with the "Irish" strain being slightly superior to the "Kentish" and "Tabor" strains.

It is intended this year to include a number of New Zealand strains for comparison.

Timothy (Phleum pratense).—Of the four strains planted on the 16th June, all germinated well but did not make much growth until early in November. At no time during the year could their growth be regarded as good. The most outstanding strain was the pedigreed Welsh, but even this did not produce an even growth.

Cocksfoot (Dactylis glomerata).—Three imported strains of Cocksfoot were planted on 15th June; a good germination resulted. All of these made good growth, standing up well to the dry summer.

MISCELLANEOUS GRASSES.

Fescue (Festuca rubra).—The germination of the two plots grown was excellent. Both produced a good even stand of fine grass. This species may prove useful when incorporated as a bottom grass in pastures.

Wheat Grasses (Agropyron spp.).—Both the "Slender" and "Crested" Wheat Grasses were planted. Early in the season they came away very slowly, but during the summer the "Slender" Wheat Grass produced a fair bulk nearly equal to that of Cocksfoot. Both withstood the summer and are doing well. The "Crested" Wheat Grass is much more prostrate in habit than the "Slender."

Of the other grasses growing, those showing most promise are *Brome Grass (Bromus sp.), Tall Oat Grass (Arrhenatherum elatius),* and *Dhaman Grass (Pennisetum sp.).* The "Tall Oat Grass" had made exceptionally good even tufty growth and produced a good bulk of feed.

MISCELLANEOUS.

Of the 10 miscellaneous fodder plants grown, the following have survived the summer months and produced a good bulk of feed:—Sheep's Burnet, Sheep's Parsley, and Chicory. Of the remaining, Tree Lucerne (*Cytisus sp.*), Ribgrass (*Plantago lanceolata*), and *Plantago maritima* are the best.

WOOL WEEK.

HUGH McCALLUM, Sheep and Wool Inspector,
and
W. McC. JOHNSON, Cadet.

Westralia's "Wool Week" has proved a great success and should give a stimulus to the wool industry.

Dame Fashion this season has sided with the primary producer and decreed that woollen material shall be "the cloth" for the winter, and with the revival of hand knitting the spending power of the feminine section of the community, at least, will be diverted to the purchase of wools. For many years wools have been used in the manufacture of "flock" for filling mattresses, upholstery, etc., but this year its use, after simply scouring and teasing, is being advocated for bedding, pillows, quilts and cushions, and this should absorb a large quantity of the crossbred wools that do not find such a ready market for the overseas trade.

Great interest was manifested in the "Wool Queen" competition, and Miss Coyne is to be congratulated on gaining first place. The "Miss Westralia" frock competition was a most successful effort, and had the support of many country centres, and the organisers must feel very proud of the result of their labours. The entries in the many knitting and frock competitions conducted by the different firms have been numerous and some splendid work is to be seen.

Some wonderful displays, depicting the stages in manufacture and the many uses to which wool can be put, have been arranged in the windows of all the leading firms, and, judging by the crowds gathered round the windows, the man in the street, together with his wife, daughters and sons, found them most interesting and, no doubt, instructive. Several of the shops arranged for an expert hand knitter to be in attendance to give instruction and assist amateurs in making up the wool purchased, and in every case the knitter has had a large and varied class each day.

The Empire procession had a special section for wool, and the leading float gave pride of place to a very fine ram, the imposing sire of Westralia's wool producers, mounted on a hillock of wool and gazing proudly down on the exhibits manufactured from the coats of his many relations. An old time drag carried many members of the old pastoralist families, and the Premier rode in state on the driver's seat. The pioneers, pastoralists, boundary riders all took their part, even to several native inhabitants of the State. One large lorry drawn by five magnificent horses, carried 40 bales of wool, showing the early method of transport. The float of the metropolitan surf-clubs added a note of colour with the members in their gay woollen parade costumes manning a surf boat. They showed how attractive well-knitted woollen material could look, and yet permit of easy movement and every comfort, and how they, in addition to saving the lives of those in danger from the sea, were helping to save the pastoralists by increasing the demand for woollen goods.

In the industrial section were some very fine exhibits of woollen goods which, by their quality, clearly demonstrated the vast improvement which has been made in the manufacture of woollens locally. With the wide variety of choice materials and designs now available at the various local mills, it is rather astonishing to see that Westralia imports any woollens at all.

With the interest and support that has been given to "Wool Week," there can be no doubt that the public is keenly aware that the future prosperity of the State depends largely on her woollen industry and is doing its best to stand firmly behind it.

PURITY OF RYE-GRASS STRAINS.

THE USE OF FILTERED ULTRA-VIOLET LIGHT IN DIAGNOSIS OF THE VARIOUS TYPES OF RYE-GRASS (*Lolium spp.*).

H. G. ELLIOTT, Agric. Adviser, Dairy Branch.

Owing to the extreme difficulty in detecting de-awned Italian Rye-grass (*Lolium perenne* var. *multiflorum*) in samples of perennial rye-grass seed (*Lolium perenne*), the recent discovery by Dr. G. Gentner of the State Seed Control Station, Munich, is a matter of outstanding importance. He demonstrated that seedling roots of Italian rye-grass grown on white Whatman filter paper cause a condition on the paper which when viewed under filtered ultra-violet light of the 3,000/4,000 Angström Unit Band would render it fluorescent, while the seedlings of pure perennial rye-grass under identical conditions would not.

Linehan and Mercer, of the Department of Agriculture, Northern Ireland, applied Gentner's method to the commercial rye-grasses of Great Britain, with the result that the phenomenon of fluorescence was found not to be confined to Italian rye-grass, as other annual species of *Lolium* and certain other plants, such as oats, do so brilliantly, and that it is possible to distinguish seeds of perennial rye-grass from de-awned seeds of Italian rye-grass by this method within a marginal error of 10 per cent. They found also that certain seedlings of apparent perennial rye-grass are found to exhibit fluorescence, which by "growing-on" tests were identified as intermediate false perennials.

N. R. Foy, of the Plant Research Station, Palmerston North, New Zealand, tested out over 500 samples, the majority of which had been previously classified by plot trials. He considers from the evidence he obtained that the value of the quartz lamp in the diagnosis of potential plant-type in rye-grass has been established, and states that "it must be accepted that—

"(a) Genetically pure perennial does not exhibit flourescence, or is always negative;

"(b) Genetically pure Italian does exhibit fluorescence or is always positive;

"(c) The hybrid individual may or may not exhibit fluorescence;

"(d) For each of the classes of rye-grass there is a more or less definite proportion in which the positive and negative reacting individuals occur;

"(e) The proportion of fluorescent individuals is smallest in the most persistent class and greatest in the least persistent class; there is a distinct negative correlation between the proportion of fluorescent individuals characteristic of the class and the degree of persistency."

Experiments conducted by this department have been very satisfactory. This application of the ultra-violet light test to all trade samples would hasten the disappearance of the less persistent types of rye-grass.

The writer wishes to acknowledge his indebtedness to Mr. H. L. Ball, of Messrs. W. Watson and Sons, Perth, for the use of apparatus for the tests already carried out.

EXPERIMENTS WITH "RHENANIA" PHOSPHATE IN WESTERN AUSTRALIA.

L. J. H. TEAKLE, G. K. BARON-HAY, I. THOMAS, Department of Agriculture.

The advance of the sciences of chemistry and engineering has enabled the fertiliser manufacturers to produce better and cheaper fertilisers for the maintenance and improvement of soil fertility. There is now no need to fear a shortage of nitrogenous fertilisers. Similarly, more concentrated and readily available phosphatic fertilisers are produced more cheaply as a result of improvement of technique and the introduction of new methods.

"Rhenania" phosphate, one of these products, is the result of the use of a new method of treatment of rock phosphate. It is a concentrated fertiliser supplying 25-30 per cent. ammonium citrate soluble phosphoric oxide (P_2O_5) in the form of a calcium-alkali phosphate. The ground rock phosphate is heated in a rotatory furnace to a temperature of 1,100deg. to 1,200deg. C. with alkali salts. A chemical change occurs whereby two-thirds of the calcium is replaced by the alkali metal giving an available phosphate, soluble in ammonium citrate. The mass is removed from the furnace as a clinker and is then finely ground and sold as a light grey powder under the name of "Rhenania Phosphate." The availability of the phosphate compares with that of dicalcium phosphate. It is alkaline in reaction due to calcium silicate and in this respect resembles basic slag.

As a fertiliser it has been studied extensively in Germany and to a less extent in other parts of the world. Niklas, Strobel and Scharrer (1) organised a comprehensive plot experiment to compare "Rhenania Phosphate" with superphosphate and Thomas phosphate. He found that "Rhenania Phosphate" and superphosphate gave similar increases in yield of barley, wheat, oats, spinach, sugar beet, lucerne, etc., and were superior to Thomas phosphate.

Further experiments by the same authors (2) on four different types of soil led to similar results with oats, potatoes, rye, barley and beans.

von Rath (4) concluded that Rhenania phosphate was superior to superphosphate for cereals and equal to superphosphate for sugar beet. The cost for each fertiliser was the same.

These and other results aroused an interest in Rhenania phosphate as a fertiliser. Through the courtesy of Privatdozent Dr. L. Meyer, of the Plant Nutrition Institute at Hohenheim, Germany, arrangements were made with the Kali-Chemie Company for the provision of a parcel of this fertiliser for experimentation in Western Australia. A parcel of 1,000 kilograms (approximately one ton) was supplied gratis and this was used by the Wheat Branch and the Dairy Branch of the W.A. Department of Agriculture in experiments in 1930 in various parts of the State. The Rhenania phosphate was compared with superphosphate—

1. When the same weight of fertiliser was used per acre.
2. When the same weight of phosphoric oxide (P_2O_5) was used per acre.

A.—THE RESULTS WITH WHEAT.

The results with wheat have been published by Thomas (5).

The trials were arranged at the Merredin Experiment Farm, about 170 miles East of Perth, and at the Wongan Hills Light Lands Farm, about 130 miles North of Perth.

1.—*At Merredin Experiment Farm.*

The experiments at Merredin were on the typical heavy textured forest soil of the Mallee Zone (Prescott (37)) of Western Australia. This zone receives an annual precipitation of 11 to 16 inches, of which 60 to 70 per cent. falls in the cool season (May to October).

The properties of the soil are represented by the analysis of Prescott (3) which is reproduced in Table 1.

TABLE 1.

COMPOSITION OF A TYPICAL GIMLET (EUCALYPTUS SALUBRIS) SOILS OF THE MALLEE ZONE (PRESCOTT (8).)

MERREDIN, WESTERN AUSTRALIA.

Depth in inches	0—4ins.	4—12ins.	12—18ins.	18—28ins.	28—42ins.
Horizon	A.	B_1.	B_1.	B_2.	B_2C.
	%	%	%	%	%
Coarse sand	36·7	21·5	16·9	15 3	16·9
Fine sand	23·3	15·0	14·7	13 6	14·1
Silt	14·9	12·8	13·8	10·4	7·2
Clay	20·8	43·0	46·2	48·8	43·4
Loss on acid treatment	0·5	0·8	1·4	5·3	12·6
Moisture	3·2	6·6	7·9	8·1	6·3
Loss on ignition	5·4	6·8	6·9	8·0	10·5
Nitrogen	0·06	0·05	0·05	0·03	0·02
Carbon	1 01	...	..	..	...
Calcium carbonate	0·02	0·02	0·26	4 40	11·80
Sodium chloride	0·02	0·06	0·17	0 17	0·25
Reaction—pH	6 7	7·4	8·2	8 6	8·8

The land had been under cultivation for about 25 years and during that period had received applications equivalent to from 5 to 6 cwts. per acre of superphosphate containing 22 per cent. P_2O_5. The early variety, Gluyas Early, was sown at the rate of 45 lbs. of graded seed per acre, with the requisite amount of phosphatic fertiliser in a grain and fertiliser drill on well prepared fallowed land.

The season was average in total rainfall, but was dry in May, September, and October, thereby reducing yields. For 1930 the precipitation was 13.33 inches, of which 8.23 inches fell in the months of May to October.

2.—*At the Wongan Hills Light Lands Farm.*

This district generally receives a slightly heavier rainfall than at Merredin and a greater portion (70 to 80 per cent.) falls in the May to October season. For 1930 the precipitation was slightly less than Merredin; 12.99 inches, of which 10.48 inches fell in the May to October period, were recorded at Wongan Hills Light Lands Farm.

The soil is a grey sand on yellow sand with more or less lateritic pebbles through the mass. It is formed from ancient laterites or similar material, and in no way resembles the normal soils of the district. It is of low inherent fertility and carries a low scrub of harsh shrubs. The soil is slightly acid in reaction, giving a pH 5.5-6.0 (quinhydrone electrode) and is so deficient in available phosphate that no growth of cereals is obtained without phosphatic fertilisation.

The plots were on fallowed land which had not previously carried a crop nor received any fertiliser treatment. The midseason variety "Nabawa" was sown at the rate of 45 lbs. of graded seed per acre with the requisite fertilisers in a grain and fertiliser drill.

Table 2, taken from Thomas (5), summarises the results obtained with wheat in the 1930 season at the Merredin and Wongan Hills Experiment Farms.

TABLE 2.

COMPARISON OF RHENANIA PHOSPHATE WITH SUPERPHOSPHATE AS AFFECTING THE GROWTH OF WHEAT AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM, 1930.

Rhenania Phosphate—28·4 per cent. Phosphoric Oxide—(P_2O_5)
Superphosphate—22 per cent. Phosphoric Oxide—(P_2O_5)

(Figures are averages of yields from five replicated plots, all plots similarly treated giving concordant results.)

Fertiliser Treatment.	Merredin Experiment Farm—1930 Season.		Wongan Hills Light Lands Farm—1930 Season.	
	Average Yield, bushels per acre.	Per cent.	Average Yield, bushels per acre.	Per cent.
150lbs. per acre Rhenania phosphate	29·8	97	9·5	55
150lbs. per acre Superphosphate (control)	30·7	100	17·3	100
110lbs. per acre Rhenania phosphate (equivalent P_2O_5)	28 7	94	8·4	49

B.—RESULTS WITH PASTURE.

The results of the experiments with pasture carried out by the Dairy Branch have been made available by Mr. G. K. Baron-Hay in a departmental communication. The experiments were arranged in the high rainfall districts in the South-Western portion of the State South of Perth. The fertilisers were applied as top dressings and the results compared with the yields of the plots treated with superphosphate. The yields were estimated from cuttings made at one or two periods.

The soils used cover a representative range in the clover belt of Western Australia. They are generally slightly acid in reaction and enjoy a rainfall ranging from 30 to 50 inches per annum.

The results reported by Mr. Baron-Hay are summarised in Table 3.

The experiments were arranged in triplicate and the yields calculated by averaging the weights of green herbage obtained from measured quadrats taken at five sites on each plot. The yields of individual plots under similar treatment varied considerably in certain cases so that small differences are not significant. From the summary in Table 3, it appears that generally Rhenania phosphate is not equal to superphosphate as a source of phosphate under the conditions in this district.

TABLE 3.

SUMMARY OF RESULTS OF EXPERIMENTS WITH SUPERPHOSPHATE AND RHENANIA PHOSPHATE ON PASTURE IN THE SOUTH-WEST OF WESTERN AUSTRALIA, 1930.

Superphosphate—22%, P_2O_5. Rhenania phosphate, 28·4%, P_2O_5.

Weights given are for green material harvested.

Farm.	District.	Rainfall inches per year.	Cutting.	Date, 1930	Superphosphate, 150 lbs. per acre (Control).		Rhenania Phosphate 110lbs. per acre.		Rhenania Phosphate 150lbs. per acre.	
					Tons per acre.	Per cent.	Tons per acre.	Per cent.	Tons per acre.	Per cent.
W. Harding ...	Brunswick ...	41·97	First ...	Nov. 26	8 79	100	6·42	73	8·12	92
F. C. Smith* ...	Denmark ...	49·21	First ...	Sept. 20	8·75	100	8·53	97	7·78	89
F. Nuttman ...	Ambergate, Group 44	32·04†	First ...	Sept. 17	0·36	100	0 34	94	0·38	106
Do. ...	do. ...	...	Second...	Nov. 20	8·19	100	6·69	82	6 48	79
J. W. Pritchard*	Jardee ...	39·21‡	First ...	May 10	5·04	100	3·13	62	3 18	63
Do. ..	do. ...	...	Second...	Nov. 27	6·26	100	4·18	67	4·09	65
C. Somerset .	Balingup ...	39·21‡	First ...	Aug. 21	5 58	100	4 86	87	5 00	90
L. Temple ...	Harvey ...	40·25	First ..	Nov. 22	5·00	100	4 60	92	4 00	80
Average percentage yield (Superphosphate Control)				... ...	...	100	...	82	...	83
					Superphosphate, 112 lbs. per acre (Control).		Rhenania Phosphate 112lbs. per acre.			
					Tons per acre	Per cent.	Tons per acre.	Per cent		
C. Collins ..	Denmark ..	49 21	First ...	Nov. 16	10 97	100	11 52	105		
E. W. Grinham	Wonnerup ...	32·04†	First ...	Sept. 17	3 24	100	4·03	124		
Do. ...	do ...	...	Second...	Nov. 20	8 77	100	9·00	103		
Average percentage yield (Superphosphate Control)				... ..	..	100	..	111		

* Experiment in duplicate only. † Record from Busselton. ‡ Record from Greenbushes.

In certain cases the plots receiving Rhenania phosphate gave slightly superior measured yields. In view of these cases, it must be concluded that under certain conditions Rhenania phosphate is equal to superphosphate in improving the growth of pasture in the clover belt, but generally the yields from superphosphate treated pastures are superior.

GENERAL DISCUSSION.

The results of these experiments point to the general superiority of the water soluble phosphate under Western Australian conditions for wheat and pasture production. The response varies with the soil and in certain cases Rhenania phosphate proved equal to superphosphate, within the limits of experimental error. At Merredin the yield from wheat grown with Rhenania phosphate proved almost equal to the yield from the superphosphate plots. At this farm the residual effects of previous dressings of superphosphate is apparent, as when phosphate is withheld on these cultivated soils, the depression in yield amounts to 40 to 50 per cent. At Wongan Hills, where the soils are exceptionally deficient in phosphate, the response to superphosphate is phenomenal, and the water soluble phosphate proved greatly superior to the ammonium citrate soluble phosphate.

Results taken from Thomas and Langfield (6) and Thomas and Venton (7) are summarised in Table 4.

TABLE 4.

EFFECT OF SUPERPHOSPHATE ON THE YIELD OF WHEAT AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM.

YIELDS OF WHEAT.

Application of Superphosphate, 22%, P_2O_5. (lbs. per acre).	Merredin Experiment Farm.				Wongan Hills Light Lands Farm.	
	1929.		1930.		1930.	
	Bushels per acre.	Per cent.	Bushels per acre.	Per cent.	Bushels per acre.	Per cent.
Nil	16·5	60	12·9	46	*Nil*	...
75lbs.	25·2	91	25·2	90	12·5	82
150lbs.	27 7	100	28 1	100	15·2	100

Unit Values.—The unit value of Rhenania phosphate is lower than that of superphosphate when calculations are based on the quoted price in the country of manufacture. The comparison is shown in Table 5.

TABLE 5.

UNIT VALUES OF RHENANIA AND SUPERPHOSPHATE.
(one unit = 22 4lbs., P_2O_5, or one per cent. of one ton).

Fertiliser.	P_2O_5	Cost.	Country.	Unit Value.
	%	£ s d.		s. d.
Rhenania Phosphate	28 4	5 3 9	Germany ..	3 8
Do. do.	...	8 10 0	W.A. ..	6 0
Superphosphate	22·0	..	W.A. ..	4 0

It is seen that freight charges would prohibit the importation of Rhenania phosphate as a commercial proposition. While high grade superphosphate can be made cheaply, it does not appear likely that the manufacture of this fertiliser is justified in Australia as the return from the phosphate used is somewhat in favour of the superphosphate, more especially on extremely phosphate hungry soils.

The technical process of manufacture is a radical departure and deserves consideration. It may prove a means of utilising low grade phosphatic rock when the high grade material is not so readily available.

SUMMARY.

In this paper are described experiments in which the effect of Rhenania phosphate and superphosphate on the growth of wheat and pasture in Western Australia are compared.

The yields from Rhenania phosphate plots were generally inferior to yields from superphosphate plots. On certain soil types, in certain cases, however, the response to both fertilisers was approximately equal.

It is improbable that Rhenania phosphate would be able to compete with superphosphate under present Australian conditions.

The Department of Agriculture is indebted to the Kali-Chemie Company, Germany, for supplying the parcel of 1,000 kilograms of Rhenania phosphate gratis for experimental purposes. Thanks are extended to the company for the opportunity to study this new and effective type of phosphatic fertiliser.

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THE SOWING OF PASTURE SEEDS.

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During recent months a considerable and growing interest has been exhibited by farmers in the possibilities of improving the quality of pasture on various types of soil. This has led to numerous inquiries being received by the Department, particularly requesting information regarding the types of soil suitable for the growing of different strains of pasture plants and the rates of seeding recommended for these varieties. It, therefore, is hoped that the following notes setting out briefly the preparation of the soil required for the sowing of pasture seeds, and also the types of plants recommended for varying districts, will serve as a guide to those farmers desiring to improve or resow portions of their land to pasture.

Preparation of the Soil.—Whatever the type of soil to be planted, it is essential, in order to secure good germination, that the surface soil be of a fine tilth and that beneath this surface layer, which should be shallow, say, ¾ of an inch, the seed bed should be well consolidated.

Where mixtures containing perennial grasses are included, it is requisite that the soil should be fertile, and it therefore is undesirable, as a rule, to sow these types of pasture plants on virgin soil.

The land to be planted should be fallowed in spring, cultivation being carried out during the summer months to consolidate and also to destroy germinated weeds. Where the soil is poorly drained, ploughing should be carried out in narrow lands.

The growing of a crop of potatoes or maize during the previous summer may obviate the leaving of the land fallow, and has the effect also of enriching the soil, as these crops usually receive a heavy dressing of fertiliser containing nitrogen. Some form of summer cultivation such as that indicated above is necessary, so that the seeds may be planted and germinate early in autumn while the soil is still warm, without fear of competition from weed seeds.

Irrigated land may be freed from weeds by watering which will germinate these, and a cultivation to destroy the weeds after their germination.

Fertilisers.—Phosphatic fertilisers are essential and, on fertile ground containing a good supply of humus or organic manure, 2 cwts. of superphosphate are recommended. Where the pasture mixture contains permanent grasses, however, and there is some doubt as to the fertility of the soil, a fertiliser containing superphosphate 5 parts to 1 part nitrogen is recommended, such as superphosphate and ammonia No. 2 at the rate of 2 cwts. per acre.

Depth of Seeding.—Pasture seeds should not be sown at a greater depth than ¾ of an inch, or less than ¼ of an inch. If the land is moist to the surface, broadcasting may be practised, followed by a light rolling. A guide in depth of sowing is that "seeds should not be sown deeper than a distance equal to four times their diameter."

Method of Seeding.—Drilling is preferred, and has the advantage of giving a better and more even germination. The seed may be mixed with the fertiliser, but mixing should not take place until it is desired to sow.

Should the seed bed be firm, broadcasting the seed and fertiliser, followed by a light brush harrowing, has given good results.

Time of Seeding.— Autumn planting is the general rule. Spring planting is only recommended where sufficient moisture is present to ensure germination, or irrigation water is available.

Quality of Seed.—A great deal of attention has been paid in recent months to the differences found between strains of the same species of pasture plants. Where possible, seeds should be purchased carrying a certificate from some reputable authority, preferably a Government institution, setting out the strain, percentage of germination, freedom from disease and weed seeds. Should the seed purchased be of a low germinating capacity or a non-persistent strain, the total outlay of preparation may be wasted, or, worse still, a direct injury ensue from the harmful nature of weeds introduced.

Rate of Seeding.—The rate of application of pasture seeds per acre varies considerably from district to district, owing to the large area of the State deemed suitable for the growth of some species of pasture plants. The amount of seed to

be sown when endeavouring to establish pasture depends on several factors, as follows:—

1. Type of soil.
2. The variety and quality of seed.
3. The condition of the seed bed.
4. The seed mixture to be sown.
5. The climatic conditions governing the district in question.

In all instances, however, the aim in pasture production is to cover the surface of the land with an even sward of fodder as quickly as possible.

The following tables set out the rates of seeding recommended per acre under varying conditions:—

"A."—Where pure stands of any particular variety are to be sown without a cover crop.

"B."—For the sowing of pure stands of a particular variety with a cover crop.

"C."—The sowing of pasture mixtures under various conditions.

"A."—Pure stands without Cover Crop.—Table 1 sets out the rate of seeding recommended for single plant pastures in the three main districts of the State identified by rainfall:—

TABLE 1.

Rates of Seeding for Single Plant Pastures.

Seed.	South and South-West. 25–60in. rainfall.	Great Southern. 18—25in. rainfall.	Wheat Belt. 18in. rainfall.
	lb. per acre.	lb. per acre.	lb. per acre.
Wimmera Rye Grass	15 to 20	10 to 15	8 to 10
Italian Rye Grass	20 ,, 25	15 ,, 20	10 ,, 12
Perennial Rye Grass	20 ,, 25	15 ,, 20	...
Cocksfoot	10 ,, 12	...	...
Yorkshire Fog	6 ,, 8	...	...
Phalaris tuberosa	6 ,, 8	...	...
Timothy	4 ,, 6	...	...
Subterranean Clover	4 ,, 6	3 ,, 4	2
Drooping Flowered Clover	4 ,, 6	3 ,, 4	...
Cluster Clover	...	4	3 ,, 4
White Clover	4	...	...
Red Clover	6 ,, 8	...	...
Lucerne	8 ,, 15	5 ,, 9	2 ,, 3
Lotus major	4	...	...
Burr medic	8 ,, 12	8 ,, 10	6 ,, 8
Lupins	1 ,, 1½ bush.	1 bushel	½ ,, 1 bush.

"B."—Pure stands with a Cover Crop.—In many districts the practice of establishing pasture in two years by the use of a cover crop is quite common. The advantage of this method is that less seed per acre of the pasture plants is required, as these plants will thicken during the second year by seeding, only annual pasture plants being generally used.

Table 2 gives the rate of seeding where such pure stands are required following a cover crop, usually a cereal:—

TABLE 2.

Seeds Sown with a Cover Crop.

Seed.	South and South-West.	Great Southern.	Wheat Belt.
	per acre.	per acre.	per acre.
Wimmera Rye Grass	5 lb.	3 lb.	1 to 1½ lb.
and			
Oats	1½ bush.	1 bush.	1 bush.
Wimmera Rye Grass	5 lb.	2 to 3 lb.	1 lb.
and			
Wheat	1 bush.	45 to 60 lb.	45 lb.
Subterranean Clover	2 lb.	1 to 1½ lb.	1 lb.
and			
Oats	1 to 2 bush.	1 to ½ bush.	1 bush.
Crimson Clover	4 lb.	3 to 4 lb.	...
and			
Barley	1 to 1½ bush.	1 bush.	...
Lupins	...	6 to 10 lb.	2 to 4 lb.
and			
Wheat	...	45 to 60 lb.	45 lb.

"C."—Pasture Mixtures.—These are usually sown in the heavier rainfall districts of the State, and any mixture should contain tall strong-growing high fertility grasses with a proportion (approximately 40 per cent.) of legumes. The particular mixture decided upon is governed mainly by the type of soil available and the prevailing climatic conditions.

To assist in deciding upon the mixture to be sown, Table 3 sets out the various types of soil commonly met with in the South-West portion of the State on which it is desired to establish permanent pasture.

TABLE 3.

Soil Types for the Sowing of Pastures in the South-West.

A.—Well-drained undulating country omitting gravel hills, *i.e.*—
(1) with over 40 inches rainfall, *i.e.*, Denmark, Manjimup, Margaret River;
(2) with 30-40 inches rainfall, *i.e.*, Donnybrook, Bridgetown.

B.—Coastal plain type: Clay loam to a heavy clay carrying red gum, flooded gum, generally requires draining, *i.e.*, Benger, Cookernup, etc.

C.—Summer moist land excluding drained peaty swamp, including certain portions of Napier Creek country.

D.—Drained peaty swamps.

E.—Sandy to sandy loam waterlogged in winter, often carrying peppermint, stunted jarrah, etc., *i.e.*, low country around Busselton.

F.—Same as "E," but with clay subsoil, *i.e.*, 4-8 inches.

G.—Dry, more or less gravelly ridges.

Mixtures Recommended.—The various mixtures recommended under different conditions, and for the various types of soil indicated in Table 3 above, are concisely grouped in Table 4 according to whether the land to be sown is—

(a) Virgin land.
(b) Old cultivated non-irrigable land ("dry").
(c) Irrigated land.

In sowing these pasture mixtures, particular attention should be paid to the fertility of the soil and reference made to a paragraph on "fertilisers" earlier in this article.

TABLE 4.

Seed Mixtures for Various Soil Types—Pounds per Acre.

Seed Mixture. No.	Soil Type	Time to Sow	Perennial Rye grass	Italian Rye-grass	Wimmera Rye-grass	Cocksfoot	Paspalum	Phalaris tuberosa	Kikuyu or Water Couch Roots	Alsike Clover	Subterranean Clover	Drooping Flowered Clover	Red Clover	White Clover	Wild White Clover	Cluster Clover.	Lotus Major.	Total Weight of Seeds in Mixture.
A.—VIRGIN LAND—																		
1	A1 ...	Autumn ..	.	10			.		.		4	..		1	½	..	.	15½ lbs.
2	A2 ...	do. ..	..	10	.	.	.			.	4			.		.		14 ..
3	B ...	do. ...	.	10	or 10				.		4	1		.	..	.	..	15 „
4	C ...	Spring ..	.	.		.	12				..	..	2	½	½	.	1	16 „
5	D ...	Autumn .	..	.	.		12	.	3ft apart	.	.	...	..	½	½	.	1	14 „
6	E ...	do. .	..	..	.	..	.				.	4		.	.	...	..	4 „
7	F ...	do. ...	.	...							2	2	.		.	..	...	4 ..
B.—OLD CULTIVATED DRY LAND—																		
8	A1 ...	Autumn .	12	7	..	5		.		.		.	2	1	½	.		27½ ..
9	A1 ..	do. .	7		.		10	.				.	.	1	½	.	2	18½ ..
10	A1 ...	do. .	..	.	.			5	.					1	½		.	6½ ..
11	A2 ...	do ...	..	..	..	.	.	5	.		.		.	1	½	.	.	6½ „
12	A2 ...	do.	12	7	.	2	.				2		..	1	..	..	.	19 ,
13	C ..	do.	5	.	.		12	.		.	.	..	3	1	½		1	22½ ..
14	G ...	do	.	.	10	.		.			..	.			.	3	..	13 ..
C.—IRRIGATED LAND—																		
15	Soil heavy	Autumn-Spring	14	5	.	4	.	.		1½	.	..	3½	1	½	..	..	29½ lbs
16	Soil medium	do .	14	3		4				1	.	..	2	1	½	.	...	25½ „
17	do.	do .	7			.	10		Kikuyu (3 ft apart)		..	..	.	½	½	.	...	18 „
18	Soil light .	do .	16	3	..	3	.		.	½	1	..	2	1	½	..	1	28 „
19	General ...	do ..	10	3	.	3	.	.	Kikuyu (3 ft apart)	1	1	..	2	1	½	...	...	21½ „

THE PRESERVATIVE TREATMENT OF FENCE POSTS.

(With Particular Reference to Western Australia.)

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SUMMARY.

1. The utilization as fence posts of timbers at present destroyed in clearing farm lands and removed during the forestry practice of thinning is discussed.

2. The main causes of timber deterioration such as decay, damage by termites and borers, and the reasons for differences in the durability of different woods are given in a simple form.

3. The principles of wood preservation, including preservatives of value for fence-post preservation and the different methods for treatment, are outlined.

4. The construction of a simple farm-treating plant and methods of preparing solutions and treating posts are described in detail.

5. Schedules of treatment times for nine species of Western Australian timbers, using both oil and water-soluble preservatives, are given.

6. An estimated cost of treating posts and a discussion of the economy of treatment, together with a suitable method and examples of determining the latter, are presented.

1. INTRODUCTION.

From the earliest days of farming in Western Australia, the raspberry jam or jam post (*Acacia acuminata*) was recognized as the ideal timber for fencing purposes, and it was used in preference to all others. No reliable estimate of its life can be given, but fences constructed 50 and 60 years ago are still in perfect condition and a life of 50 years is believed to be a conservative estimate. Jam, however, generally grows on good wheat land. In addition to an increase in farming areas in the jam country, which is largely restricted to the localities adjoining the Great Southern Railway and the Midland Railway, the so-called Eastern wheat belt has been developed. This country carries little, if any, jam, the common species of timber being gimlet, salmon gum, boree, morrell, etc. None of these timbers is durable, and jam posts have been used whenever possible. Supplies of jam, however, are becoming scarcer and will become more so in the future. As well as an increased price due to increased demand and reduced supply, the Eastern wheat-belt farmer has to add the cost of freight from the source of supply and the cost of cartage from the railway. As a result of freight charges jam fence posts have been reported to be costing from £4 10s. to £7 10s. per 100 at the siding. At Narrogin and Wickepin the same posts have been quoted at £3 per 100 on siding.

In the clearing of farm lands the present practice is to destroy the greater part of the standing non-durable timber. Yet at very little extra cost fence posts could be cut from this material.

In certain districts, the Forests Department and private companies are growing crops of timbers, in the management of which thinning at definite periods is entailed. These thinnings, in the early development of the forests, would be ideal for fence posts if they could be rendered durable. Moreover, in the case of mallet in the Narrogin district, the forest produce, tannin bark, is ready for stripping when the trees are 5in. to 6in. diameter breast high.

The main purpose of this pamphlet is to show how the farmer can utilize his own stocks of timbers for fence posts by treating them with preservatives. It also indicates the possibility of the farmer purchasing untreated thinnings and subsequently treating them on his farm, or of the large scale treatment of thinnings by Government Departments and private companies for retailing to farmers as treated fence posts.

A knowledge of the fundamental causes of timber deterioration and the principles of wood preservation are desirable for a better understanding of the methods outlined later, and a short account of these subjects is therefore presented before dealing with the practical treatment of the fence posts.

2. CAUSES OF DETERIORATION OF TIMBER.

The main causes of timber deterioration are decay (rot), termites (white ants), other insects, mechanical failure, and fire. Various other causes, such as stock, floods, etc., are not of great importance.

FIG. 1.—Photograph of a highly-magnified piece of wood, showing fungus threads (the small thread-like lines running in all directions in the light-coloured bands) and holes (the smaller irregular-shaped holes, also in the lighter bands) in the wood caused by the fungus.

Decay.—Decay is often called dry rot, wet rot, doze or dote. These are not different forms of decay, and are all caused by the action of fungi which are low forms of plant life. The common mushroom, for instance, is a typical fungus.

When developed, the portion of the mushroom above the ground consists of a stalk to which is attached an umbrella-shaped, fleshy portion which is called the fruiting body. Below ground the stalk quickly disappears. If a careful search is made, however, thin white threads can be seen running out in all directions from the portion of the stalk in the ground. These white threads are somewhat similar to the roots of ordinary plants, and they extract nutriment for the growth of the mushroom from decaying vegetable matter in the soil. An extensive plant system is already developed before the mushroom appears, and this enables the very rapid growth of the edible portion. Wood-destroying fungi, however, instead of living in the ground, live in the timber, and consist mostly of fine threads which penetrate the wood in all directions, and actually absorb certain portions of it. (See Fig. 1.) As these substances are absorbed, the normal structure of the wood is broken down until it becomes soft and friable, *i.e.*, typically rotten.

At times these fine threads grow together to form thick white or pale-coloured sheets generally of a leathery texture. Sometimes, also, the threads grow out to the surface or into a large crack to form masses known as fruiting bodies. These fruiting bodies may be shaped like mushrooms or like brackets (see Fig. 2), or

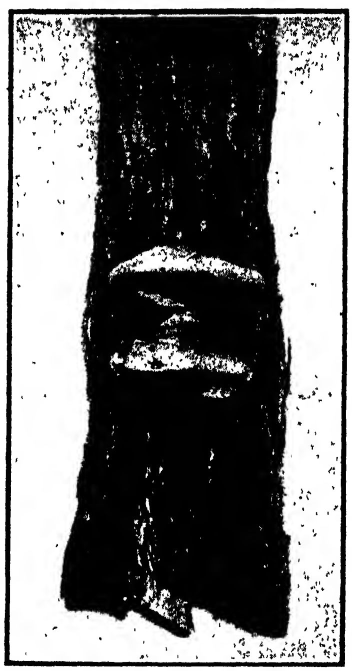


FIG. 2.—Fruiting bodies of a wood-destroying fungus.

may be quite irregular. They produce millions of small spores (similar in purpose to the seeds of ordinary plants), which, because of their minute size, are easily transported long distances by wind. An example of the number and the size of the spores is given by the common puff ball, which is a fungus. If a ripe puff ball is broken open, a fine powder like a brown smoke spreads everywhere. This powder actually consists of millions of spores. In the case of the wood-destroying fungi each spore, if it lodges on a piece of timber and the conditions are satisfactory, can germinate and set up decay.

Decay can also be conveyed to sound wood by placing it against decayed wood or by allowing small pieces of the fungus threads to come in contact with it. In other words, rot is contagious.

For fungi to develop it is necessary that certain conditions of moisture, air, and heat shall be present, together with a suitable food. The moisture required varies somewhat for different species of fungi, but it has been found that excessive moisture on the one hand or a minimum of moisture on the other will prevent growth and hence decay. Thus, wood which is waterlogged, submerged under water, or buried in continually soaked soil, will not decay; while timber which is kept continually dry will also remain free from decay. Fungi need very little air, and it is not possible under ordinary conditions of timber usage to prevent their growth by stopping their air supply. In a fence post, suitable conditions for fungus growth generally exist at the ground line. Here the moisture content of the timber is often that most satisfactory for rapid decay, and the air supply is unrestricted. The range of temperature for the growth of fungi varies somewhat, and at very high and very low temperatures growth is prevented and the fungus may even be killed. However, the weather is not always too hot or too cold, so that there are times when the temperature conditions are conducive to fungus development. Wood is the suitable food, and as the moisture, temperature, and air supply cannot be controlled in fence posts, the most practical means of combating the decay fungi is by introducing into the wood preservative materials which are poisonous to them. (See page 194.)

FIG. 3.—A typical termite mound.

Photograph kindly supplied by Mr G. F. Hill.]

Termites (*White Ants*).—Termites, popularly known as "white ants," are not true ants from the scientist's view-point. Like true ants, however, they live a social life, and in each colony there is a definite division of labour, different work being performed by various forms or castes. Some species of termites build mounds in which the colony lives, and which are very common throughout Australia. (See Fig. 3.) If a piece is broken off a termite mound so as to expose

the interior, at least two different forms or castes will always be seen. These are the worker and the soldier.

The workers (see Fig. 4) are soft-bodied, white to greyish coloured, blind, and sterile. It is this caste which causes the damage to timber structures by eating and destroying the wood. Workers also build the mounds and communication tunnels, feed the soldiers, the king and the queen, and the young of the colony.

The soldiers usually are of darker colour than the workers, are blind, have larger brownish-coloured heads, and have jaws especially shaped for defence from attacks by other insects. (See Fig. 4.) In one common group of termites the head is extended into a long snout and the jaws are undeveloped. From the end of

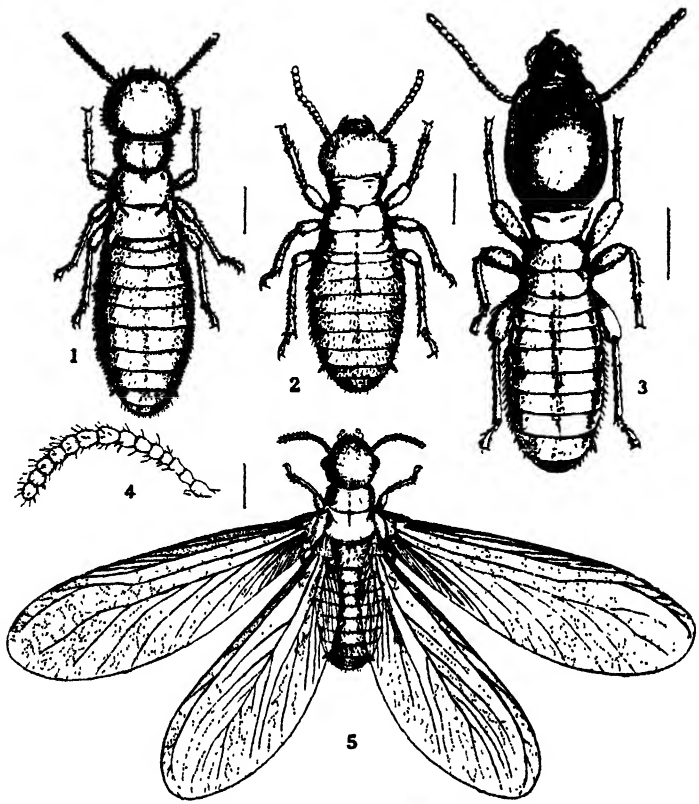


FIG. 4.—Different forms or castes of termites: 1. Immature form of winged termite. 2. Worker. 3. Soldier. 4. Antenna of the winged form. 5. Winged form. (Note.—The lines alongside each caste represents the actual size.)

Illustration from Froggatt: "Forest Insects and Timber Borers."]

the snout the soldier can eject a poison to repel other insects. The defence of the colony is the main duty of the soldiers, and it is not unusual to see them prepared to repel intruders by lining all cracks or other openings made in the mound.

Generally, in spring or autumn, long, slender, winged forms, popularly called "flying ants," may be found in the colony. They are very ant-like in character, but, unlike the worker and soldier, can see. These are the young reproductive

forms, and are either male or female. At certain periods in the year they may be seen flying from the parent colony in large numbers. If a pair of these flying forms escapes the attacks of other insects and birds and finds a suitable location, it will settle down and form a new colony.

If we break a mound open completely, we may be fortunate in laying bare the royal chamber where live the king and the queen. These are the parents of the colony, and were originally two flying forms. The queen grows to a large size and usually remains in the royal chamber, where she produces enormous numbers of eggs, which are removed by the workers to nearby chambers to hatch into young termites. When first hatched these young termites are called larvae, and are all superficially alike. Later they develop either into workers, into soldiers, or into winged forms. Some termites have the power, if the queen should die or is becoming less prolific in laying eggs, to cause certain of the older larvae to develop into further queens and, if necessary, kings. In some species of termites which do not build mounds there are no true workers as described above, the work of this caste being performed by larvae and immature stages of the winged form.

The food of termites varies, and they have been reported as living on wood, cellulose, cotton, paper, leather, grass, sugar, horn, bone, seeds, etc.

According to their nesting habits, termites may be broadly grouped into two classes, namely, subterranean and tree dwellers. The subterranean dwellers live in the soil, and often construct mounds on the ground. The tree dwellers never live in the soil or in mounds, and are generally found in galleries tunnelled in growing or dead trees. Both groups are found in Australia, the greater damage to timber structures being done by members of the subterranean group. The discussion which follows refers principally to this group, although some of the information may apply to the tree dwellers.

Termites of the subterranean group need a constant supply of moisture for their successful development and, therefore, must have a constant contact with the earth. Because of this habit it is possible to trace the entry of the termites to infested timber above ground. The termites always conceal themselves in the wood, in the ground, or in their communication or shelter tubes. To reach timber not in contact with the ground, they may enter through cracks in cement floors or brickwork (as in a house), through heart pipes or cracks in wooden-house foundation blocks, or else they may build their covered runways over any convenient surface. (See Fig. 5.) Damage above ground level may, therefore, be prevented by insuring that no access cracks, etc., are present, by periodically breaking down any runways that may be formed over the surfaces, and by suitable treatment of the surrounding soil. Special termite insulators can also be used to prevent the building of runways over exposed surfaces.

Infestation of sound timber can occur by two main methods. A termite colony which might be in the vicinity may extend its galleries to the sound timber and attack it, or the sound timber may form a suitable place for the development of a new colony by the flying reproductive forms.

Damage by termites can cause large losses of timber, and prevention of this is sometimes difficult. In the case of fence posts the only practical method is by the use of durable woods or preservative treatment in which the non-durable wood is rendered immune from attack.

Borers.—The main types of borers likely to cause damage to hardwood fence posts are the powder post borer and the auger borer. The greater part of the damage to the timber is done below the surface by the undeveloped beetle or grub form. This grub form develops into the beetle, which immediately commences to bore its way out of the wood to the surface. Where it emerges, small round holes can be seen. Generally, the attack is confined to the sapwood only, especially in the

case of the powder post borer. The auger borer, however, may extend its attack to the truewood* (or heartwood) of the post.

Softwood or pine posts may be attacked by a species similar to the so-called furniture borers. This borer will attack both the sapwood and the truewood (heartwood).

The extent of damage to fence posts by borers is thought to be small and no evidence has been obtained of posts having to be replaced because of their damage. Prevention of attack would be possible by completely treating the post with preservatives as detailed later, but the expense does not seem to be justified as a safeguard against borers alone.

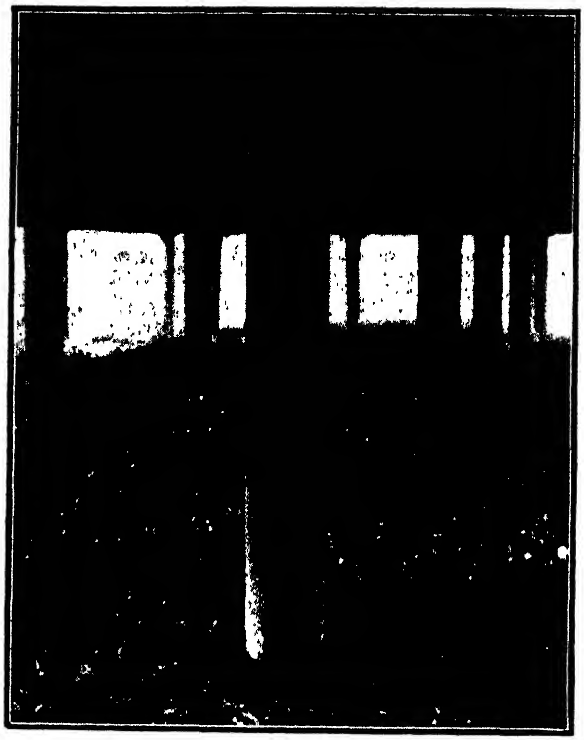


FIG. 5.—Termite communication tubes on concrete pile.

Photograph kindly supplied by Mr G F Hill |

Miscellaneous Causes.—Effective fireproofing of fence posts is not economically practicable, and no precautions can be taken against floods, lightning, etc. Mechanical failure may be due to using fence posts of too small a diameter and can be corrected by increasing the size or by using a stronger species.

3. DURABILITY OF AUSTRALIAN TIMBERS.

The durability of timber from different species of trees varies widely. One species, such as jam, will be very durable, whereas another such as mallet will be non-durable. The results of chemical and laboratory tests on durable and non-

* The term "truewood" has been adopted to describe what is usually termed heartwood. In Australia, the central portion of a tree is very often affected by decay or has little strength. This portion, which is really part of the heartwood, is called "heart." The terms "heart" and "heartwood" are therefore confusing, and that portion of the tree between the "heart," or the pith, and the sapwood has been named the truewood.

durable timbers have shown that the durable timbers contain substances which are poisonous to fungi, whereas the non-durable ones have a much less quantity of such substances or none at all. In some cases the poisonous material is an oil; in others it is probably a solid material.

Sapwood and Truewood.—The sapwood or outer part of a tree, which is usually of a lighter colour than the truewood, is chemically different from the truewood in that it does not contain substances which are poisonous to fungi or termites. As a result, sapwood does not resist decay or insect attack. A common practice in Australia is to remove the sapwood from poles and posts at and near the ground line. This practice undoubtedly prevents the more rapid attack of truewood, but it also considerably reduces the effective diameter of a pole or post, and, as the sapwood and truewood have for these practical purposes the same strength, it would be desirable to retain the sapwood. Sapwood generally is much more easily treated with preservatives and, as will be shown later, it is particularly desirable to retain it on treated posts or poles.

Conditions of Growth.—Fast-grown, young timber is frequently less durable than slow-grown, mature timber. This difference is important in the use of untreated timber, but, with effective preservative treatment, a fast rate of growth may even become an advantage, provided the younger, fast-grown material does not "pop" or split excessively either before or after treatment. Young, fast-grown material has usually a wider sapwood and a more easily penetrated structure.

Influence of Locality. -It is a popular belief that timber should be used in the locality in which it was grown in order to obtain the maximum life possible. In some cases, evidence tends to show that this is correct, but there are other factors which are much more important. The chief of these is the possibility of infection by organisms of decay or by insects being greater in one district than in another. This is shown in Western Australia. In the South-West, and in areas with an annual rainfall of more than 15 inches, the main cause of renewal of timbers is decay. In the Eastern wheat belt, and farther East and North where the rainfall is less than 15 inches annually, the decay of timber is less, but the severity and frequency of termite attack increases.

Soils, too, have an influence on durability. For instance, in soils which are continually wet the water-logged condition of the post at the ground line reduces the possibility of decay. The experience of farmers in Western Australia tends to show that in some localities there is less attack by termites on typical sandy soils than there is on those of a loamy nature. Decay can also be expected to be less serious in well-drained sandy soils.

Time of Cutting.—Contrary to the popular belief that trees should be cut only when the sap is down, the time of cutting has no effect on the durability, provided that proper care of the posts is subsequently taken. Actually there is no such state as the sap being "up" or "down" throughout a tree. Numerous tests have shown that the amount of sap in a tree trunk does not vary from winter to summer, and as a result there is no advantage to be gained in more rapid seasoning, etc. On the other hand, the influence of the seasons of the year on the rate of drying is an important factor. Very rapid drying of fence posts, especially those cut from young trees, causes an excessive number of cracks and splits. In the drier parts of Australia, felling in the winter is thus an advantage, provided the posts are immediately stacked properly. If the posts are cut in the winter, drying is not so rapid, but by the summer a large amount of drying will already have taken place. At the end of the seasoning period such posts will have less splits and cracks than those cut and stacked the same way in the summer.

4. PRINCIPLES OF WOOD PRESERVATION.

As has been stated, the development and growth of fungi require certain conditions of air, moisture, and temperature, and a suitable food. Obviously, control of the supply of air, moisture, or temperature is not possible for fence posts. The only factor that can be controlled is the food, namely, the wood. Insects, too, require certain conditions of air, moisture, and temperature, and control of their food is generally the only possible practical method. Certain woods are durable because of the presence of poisonous substances. If, therefore, materials which are poisonous to decay and insects are placed into non-durable woods they will be converted into durable ones. Wood preservation treatments are designed to introduce materials which will render the wood poisonous, and thus prevent the growth of fungi or insects. It is not necessary to penetrate the wood completely with preservatives, but only to provide a continuous outer layer of impregnated wood. In some cases this layer should cover all surfaces of the treated timber: in others (as in most cases of fence posts) it is only necessary to treat that portion to be placed in the ground and just above the ground line.

5. PRESERVATIVES.

There are large numbers of preservatives which have been, or are being, advocated for use. They may be broadly divided into two groups, namely, oil preservatives and water-soluble preservatives. Only those of particular value and interest for the preservation of fence posts in Australia at the present time will be discussed.

(a) *Oil Preservatives.*

Coal-tar creosote is an oil prepared from coal-tar. The results of extensive tests and of experience in other countries have shown that this oil is the most effective for general purposes. It is, however, dark coloured, and has a distinct odour, both of which may in some cases be undesirable. Creosote oil varies considerably in quality, but any good grade oil will give good results, provided there is sufficient of it introduced, and that the penetration of the oil into the wood is satisfactory (see Appendix 1).

Tar is often used for brushing or painting the ends of posts, etc., but it is of very doubtful value. It is much less poisonous to fungi and insects than is creosote and its penetration into the wood is less than with creosote used under the same conditions. Its use is not recommended.

Petroleum Oils.—These are not sufficiently poisonous enough to fungi to prevent decay, and their use for prevention of insect attack cannot at present be recommended.

Creosote and Oil Mixtures.—Where the cost of creosote is high, it is an economy to dilute it with a petroleum oil. Naturally, pure creosote is more satisfactory, but creosote, if of a good grade, is generally sufficiently poisonous to withstand some dilution with non-poisonous oils. The use of the crude oil lowers the cost of the preservative or for the same expense provides a better distribution of the creosote in the wood. The best oil for dilution is crude petroleum, or a light fuel oil which may be added to form a solution consisting of *2 parts of creosote to 1 part of oil.* The treatment schedules given in Table I. Schedule of Treatment were obtained by using this mixture.

Patented or Proprietary Oil Preservatives.—There are a number of these available; some are good and some are of doubtful value. They are usually more expensive than ordinary creosote and any one proposing to use them should make thorough inquiries, and if possible ask for advice from the Division of Forest Products.

(b) Water-Soluble Preservatives.

The principal water-soluble preservatives available for use in Australia at present are sodium fluoride, zinc chloride, and white arsenic (arsenic).

Sodium fluoride is a white powder which is soluble in water, about 4 lb. of it dissolving in 10 gallons of water at ordinary temperatures. It is very poisonous to fungi, but not to termites. The use of white arsenic, in addition to the sodium fluoride, is therefore necessary.

Zinc chloride is sold in a solid form or in a heavy concentrated solution containing about 50 per cent. zinc chloride. It is very soluble in water. Like sodium fluoride, it is very poisonous to fungi, but not to termites.

White arsenic (also sold commercially under the name "arsenic") is a whitish powder which is slightly soluble in water, about 2 lb. of it dissolving in 10 gallons of water at ordinary temperatures. It is not easily dissolved in water unless the solution is boiled vigorously, because the white powder floats to the surface and is difficult to wet. Experience over a large number of years has shown that white arsenic is a very effective poison against termites. Where both fungi and termites are likely to attack the timber, a solution containing white arsenic with either sodium fluoride or zinc chloride is recommended. In the drier localities, it is possible that treatment with white arsenic alone would be effective, and experiments are now being made to test this belief.

Patented or Proprietary Water-soluble Preservatives are available sometimes in powder form and sometimes in solution. Usually, the actual composition of these preservatives is not given, and as their value varies considerably, any one proposing to use them should fully investigate their efficacy first.

6. METHODS OF TREATING TIMBERS.

The objective in the treatment of timber is to introduce the preservatives into the wood so that a deep layer of preserved wood and a sufficient quantity of preservative to prevent decay and termite attack is obtained. The following methods are generally used:—

Pressure Processes.—These methods involve the use of a large specially constructed preservation plant. The timber to be treated is loaded on special trucks and is run into long steel cylinders which are then closed. Depending on the actual process to be used, the timber is first subjected to a vacuum or to air pressure, the cylinder is then filled with solution, and pressure is applied until the wood absorbs the required amount of solution. A final vacuum treatment is then often given. Where facilities are available this is the most satisfactory method for treating wood. It is not at present in use in Australia.

Open Tank Process.—For use on the farm with its natural limitations, the open tank process is the most satisfactory and practicable. The timber to be treated is placed in a tank of hot preservative and heated therein for some hours. During this heating period the air which is present in the cells of the wood is heated. It thus expands, and some of it is in consequence expelled. At the end of the heating period, the timber is either quickly removed to a separate tank containing cold preservative or else it is left to cool down in the same tank. During this cooling period, the remaining hot air in the cells cools and contracts, and the preservative is sucked in.

Generally, for the treatment of fence posts, only that portion of the post inserted into the ground, plus a further 6 inches to show above the ground, is inserted into the preservative.

Only seasoned or dry timber can be satisfactorily treated by this method. Except for timber which is very easily treated, there is practically no absorption of preservative during the heating period. All absorption takes place during the cooling or cold bath treatment. If too much preservative is being absorbed by the wood, the duration of the cooling treatment can be shortened. By increasing the length of time of the heating period, it is possible, up to a certain limit, to increase the penetration of the preservative. Full details and times of treatment are given in Tables I. and II.

Steeping Process.—This is used with water solutions only, and consists of soaking the dry wood in the cold solution, preferably for some weeks. On account of the long time required for treatment, and the fact that good penetration and absorption of the preservatives are not usually obtained, its general use cannot be recommended.

Dipping Process.—This consists of placing the seasoned fence posts in the hot preservative solution for a short period—generally five to fifteen minutes. Very little penetration and absorption of preservative into the wood occurs, although all surfaces and cracks are generally well coated with the preservative. Only oil preservatives should be used with this process. With water solutions, the thin coating so obtained is easily washed off by rain, and so their use is not advocated. As the preserved layer of wood is very thin, and the amount of preservative absorbed very small, long life cannot be expected from timber so treated. The treatment probably justifies the expense, and is advantageous in that large numbers of posts can be quickly treated at a relatively small cost.

Brushing Processes.—These consist of brushing, painting, or swabbing the preservative into the timber. Only oil preservatives are satisfactory for this purpose, and they should be brushed on hot, preferably at about 200 deg. F. Every care should be taken to ensure that the oil is forced into all cracks or defects in the wood. Several coatings should be applied, each coating being allowed to dry before the next is commenced. The use of hot oil allows the cracks, etc., to be more easily treated. The method is not as satisfactory as dipping, and good results should not be expected from its use. It is cheap, and large numbers of posts can be quickly treated with a minimum of preservative. Only well-seasoned wood should be used, because, with green timber, further cracks will occur on drying, and these will immediately expose untreated wood. Fence posts should be painted in order to coat the portion being placed in the ground, together with a further 6 inches above the ground.

Brush treatments are of value for those parts of a construction which cannot be treated by other means; for recoating treated portions which have been cut into for erection purposes; or for coating contact points where decay is likely to occur.

7. ABSORPTIONS AND PENETRATIONS NECESSARY FOR EFFECTIVE TREATMENT.

The effectiveness of any preservative treatment depends upon having a continuous, unbroken, outer layer of preserved wood containing a sufficient quantity of preservative to prevent fungal and insect attack. Experiments in the preservation of Australian timbers for fence posts have shown that the penetration in the truewood of split posts is very small—generally less than ⅛ of an inch. The sapwood is more easily treated, and by the open tank process complete, or almost complete, penetration can be obtained. With all the Western Australian species except gimlet, the sapwood is usually ½ of an inch, or more, in thickness, and

this can be effectively treated. In gimlet, the sapwood is generally less, but it takes treatment fairly well. A depth of ½ an inch of unbroken treated wood is regarded as a very satisfactory protection.

The necessary amount of preservative varies with the preservative and the type of attack expected. Using a mixture of 2 parts of creosote to 1 part of fuel oil a 4-in. butt diameter fence post, if treated to a height of 2 ft. 6 in. from the butt, should absorb about 1½ lb., a 5-in. post about 2 lb., and 6-in. post about 2¼ lb., of preservative. This quantity is equivalent to 7 lb. of creosote and oil mixture per cubic foot of wood which is treated, *i.e.*, per cubic foot of post for 2 ft. 6in. from the butt. Experience in other countries has shown that with zinc chloride and sodium fluoride, about ½ lb. of dry salt is needed per cubic foot of wood in order to prevent decay. In Australia, about ¼ lb. of white arsenic per cubic foot has been found effective against termites. Using solutions containing 3½ per cent. sodium fluoride or 3½ per cent. zinc chloride together with 2 per cent. white arsenic, a 4-in. butt diameter fence post should absorb about 3 lb., a 5-in. post about 4 lb., and a 6-in. post about 4½ lb. of solution (1 gallon of solution weighs about 10 lbs.). This is equivalent to about 14 lb. of solution per cubic foot of wood. With water solutions, on account of the possibility of their being washed out by water, it is advisable to treat the timber so that it absorbs as much solution as possible.

(*To be continued.*)

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

SALMON GUMS EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms, and L. G. SEINOR, Farm Manager.

The following are the monthly rainfalls as recorded at the farm during 1931, together with the averages for the six years this farm has been established.

—	Jan.	Feb	Mar	Apl	Growing Period.							Nov.	Dec	Total for year
					May	June	July	Aug	Sept.	Oct	Total			
1931	...	179	2	74	246	232	175	408	81	163	1,305	98	11	1,669
Average, six years	27	59	169	94	152	131	145	207	80	100	816	50	63	1,277

Good rains were experienced towards the end of February and presented a good opportunity for working fallowed land. Rain which fell about the middle of April germinated weed seeds and facilitated the control of weed growth.

The subsequent rainfall was ideal for wheat crops. Very severe frosts were recorded during the growing period, and these retarded crop growth. Late frosts, up to the 12th of October, also caused some damage.

The land on which the experiments set out below were conducted was of a reddish colour, originally timbered with teatree, silver bark, mallee, and light mallee. It had been cropped twice previously, in 1927 without being fallowed, when only a light yield was obtained, and in 1929 after fallow.

During June and early July, 1930, it was ploughed to a depth of 3 to 4 inches with a disc implement. This was followed by a springtyne cultivation in early October and again immediately prior to seeding.

Time of Seeding Experiment.

The object of this experiment is to determine the most suitable time for planting the wheat crop.

Two varieties were used, the midseason variety, Nabawa, being sown in mid-April, May and June, and the early variety, Gluyas Early, in mid-May, June and July.

The tables of results are hereunder:—

TIME OF PLANTING EXPERIMENT.

Variety Nabawa. Seed - 45lb per acre. Superphosphate 112lb per acre

Time of Planting.	Computed Yields per Acre. Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Average Yields per acre. 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928-31	Percentage Yields 1928-31.
	bus lb	bus lb.	bus lb	bus. lb	bus lb.	bus. lb	%	bus lb	%
April 9th	17 20	17 4	14 32	14 32	12 24	15 10	105	14 28	106
May 9th	17 28	14 8	13 44	15 4	11 52	14 27	100	13 37	100
June 12th	10 40	10 16	9 52	8 40	9 36	9 49	68	8 13	60

TIME OF PLANTING EXPERIMENT

Variety—Gluyas Early. Seed—45lb per acre Superphosphate 112lb per acre.

Time of Planting	Computed Yields per Acre. Sec. 1	Sec 2	Sec 3	Sec 4	Sec. 5	Average Yields per acre 1931.	Percentage Yields, 1931	Average Yields per acre 1928-31	Percentage Yields, 1928-31.
	bus lb	bus lb	bus lb	bus. lb.	bus lb	bus lb.	%	bus lb	%
June 14th	10 0	10 0	9 4	8 40	9 12	9 23	94	11 28	79
May 14th	10 32	10 40	10 0	9 4	9 52	10 2	100	14 36	100
July 20th . .	9 36	8 32	6 56	6 16	6 48	7 38	77	9 3	62

This experiment again demonstrates that the yields of both early and mid-season varieties are considerably reduced when the crop is planted later than the month of May.

The seeding calendar for the Esperance wheat area, in which this farm is located, is as follows:—

Variety.	Maturity.	NORTHERN. Beete, Kumarl, Dowak and Salmon Gums.	CENTRAL. Circle Valley, Red Lake and Grass Patch.	SOUTHERN. Treslove, Scaddan.
Yandilla King ...	Late ..	... .	April 1st to 15th ...	April 1st to 21st
Nabawa	Midseason ...	April 15th to May 7th	April 15th to May 7th	April 21st to May 21st
Gluyas Early ...	Early ...	May 1st to May 21st	May 1st to May 21st	May 10th to 31st
Noongaar ...	Very Early...	May 21st to 31st ...	May 21st to 31st	

Time of Application of Superphosphate Experiment

This experiment was conducted to determine whether, when applying heavy dressings of superphosphate, it would be profitable to apply part or all of the fertiliser when cultivating the fallowed land in late summer or early autumn, thus allowing seeding operations to be expedited.

The tablulated results for 1931, together with the averages for the previous years, are as follows:—

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT

Planted on 28th May, 1931 — Variety Nabawa — Seed 45lb per acre

Time of application of Superphosphate	Computed Yields per Acre										Average Yields per acre 1931		Percentage Yields 1931	Average Yields per acre 1928-31		Percentage Yields, 1928-31.
	Sec 1		Sec 2		Sec 3		Sec 4		Sec 5							
	bus	lb	bus	lb	bus	lb	bus	lb	bus	lb	bus	lb	%	bus	lb	%
75lb in April 150lb at seeding	16	0	14	0	13	4	12	32	13	28	13	49	115	14	10	110
225lb in April	10	32	12	24	11	20	11	44	13	44	11	56	100	13	19	100
150lb in April 75lb at seeding	15	52	12	48	13	36	13	20	13	4	13	44	114	14	6	106

The average results for the four years that the experiment has been conducted show that the yields are decreased when a portion of the fertiliser is not applied at seeding time.

Rate of Application of Superphosphate Experiment.

This experiment was divided into two sections in order to test the effects of applying the following amounts of superphosphate to the wheat crop—

Section 1— 300 lb. per acre.
150 lb. per acre (Control).
225 lb. per acre.

Section 2—No superphosphate.
150 lb. per acre (Control).
225 lb. per acre.

The following tables show the results obtained:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT

Planted on 9th May, 1931 — Variety—Nabawa — Seed 45lbs per acre

Rate of application of Superphosphate per acre.	Computed Yields per Acre										Average Yields per acre, 1931		Percentage Yields, 1931	Average Yields per acre, 1929-31		Percentage Yields, 1929-31.
	Sec 1		Sec 2		Sec 3		Sec 4		Sec 5							
	bus.	lb.	bus	lb.	bus	lb.	bus	lb	bus	lb.	bus	lb	%	bus	lb	%
No super	6	0	10	40	8	8	8	48	7	44	8	16	54	7	9	48
150lb. . . .	14	40	17	12	15	12	15	28	15	44	15	39	100	15	2	100
75lbs.	17	12	15	4	14	24	15	52	15	44	15	39	100	14	14	95

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 4th May, 1931. Variety—Nabawa. Seed—45lb. per acre.

Rate of application of Superphosphate per acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929–31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
300lb.	16 8	17 20	18 16	19 20	18 48	17 58	102	15 30	105
150lb.	16 0	18 40	17 20	17 52	17 52	17 33	100	14 48	100
225lb.	17 44	17 20	18 48	17 44	17 12	17 46	101	15 33	105

These results indicate that the yields are increased when heavier rates of superphosphate are applied.

Under present economic conditions, however, the rate of 112 lb. per acre appears to be the most economical.

Nitrogen Experiment.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. per acre respectively, the applications in each case being at planting time.

Superphosphate was applied to all plots at the rate of 112 lb. per acre, and those plots which received superphosphate only were treated as controls.

The experiment was conducted on both fallowed and unfallowed land, the results being shown hereunder:—

NITROGEN EXPERIMENT.

NON FALLOW SECTION.

Planted on 8th May, 1931. Variety—Nabawa. Seed—45lb. per acre. Superphosphate—112 lb. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930-31.	Percentage Yields, 1930–31.
	bus lb	bus. lb.	bus. lb.	bus. lb.	bus. lb	bus lb.	%	bus. lb.	%
112lb	8 40	7 28	9 44	11 28	11 28	9 46	97	10 54	96
Nil	10 40	10 0	10 32	9 20	9 52	10 5	100	11 23	100
224lb.	9 44	10 32	10 0	10 32	9 44	10 6	100	11 13	99

FALLOW SECTION

Planted on 8th May, 1931. Variety—Nabawa Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre. Section 1.	Section 2.	Section 3.	Section 4.	Section 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Percentage Yields, 1929–31
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
112 lb.	14 0	14 16	10 24	10 32	11 12	12 5	106	98
Nil	10 56	13 28	10 32	11 44	10 32	11 26	100	100
224 lb.	13 12	11 36	11 12	10 8	10 56	11 25	100	93

These results do not indicate any increase in yield from applying a nitrogenous fertiliser to either fallowed or unfallowed land.

Manganese Experiment.

The object of this experiment is to determine whether any increase in yield is obtained by applying, in addition to superphosphate, a manganese fertiliser to the wheat crop at planting time.

Manganese sulphate was applied as follows:—

Plot No. 1—28 lb. manganese sulphate.

Plot No. 2—Nil (control).

Plot No. 3—56 lb. manganese sulphate.

Superphosphate was applied to all plots at the rate of 112 lb. per acre.

The following results were obtained:—

MANGANESE EXPERIMENT

Planted on 18th May, 1931. Variety Gluyas Early. Seed—45 lb. per acre Superphosphate—112 lb. per acre.

Quantity of Manganese Sulphate per acre.	Computed Yields per Acre					Average Yields per acre, 1931	Percentage Yields, 1931
	Section 1	Section 2	Section 3	Section 4	Section 5		
	bus lb.	bus lb	bus lb	bus lb	bus lb	bus lb	%
28 lb.	14 0	13 20	11 52	12 16	12 56	12 53	95
Nil (Control)	13 44	13 12	12 56	13 28	14 16	13 31	100
56 lb .	13 36	11 28	12 56	10 56	13 28	12 29	92

These results are similar to those obtained at the other experiment farms and indicate that no substantial increase in yield was obtained by the application of a manganese fertiliser to the wheat crop.

Depth of Ploughing Experiment.

The object of this experiment, which has been conducted for the past three years, is to determine the most economical depth to plough for the wheat crop.

Three plots, each repeated five times, were required, one ploughed to a depth of 2 inches, one to 4 inches, and one to 6 inches.

The plots were all ploughed the previous June with a disc plough, springtyne cultivated in early October, and again immediately prior to seeding.

The results are shown hereunder:—

DEPTH OF PLOUGHING EXPERIMENT

Planted on 8th May, 1931. Variety—Nabawa Seed—45 lb per acre Superphosphate—112 lb. per acre

Depth of Ploughing	Computed Yields per Acre				Average Yields per acre, 1931.	Percentage Yields, 1931	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31.
	Section 1	Section 2	Section 3	Section 4				
	bus. lb.	bus. lb.	bus lb	bus. lb.	bus lb.	%	bus lb.	%
2in. deep	11 4	10 40	11 20	10 40	10 56	101	11 48	93
4in. deep	11 12	10 0	11 36	10 40	10 52	100	12 38	100
6in. deep	11 52	9 12	11 52	10 0	10 44	99	12 14	97

Both this year's results and the average results for the past three years indicate that there is no advantage to be gained by ploughing to a depth greater than 4 inches.

Time of Ploughing Experiment.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yields of the resultant wheat crop.

Three plots, treated in the following manner, were required:—

Plot 1—Ploughed in March, 1930 (long summer fallow).
Plot 2—Ploughed in June, 1930 (early winter fallow).
Plot 3—Ploughed in September, 1930 (late winter fallow).

The March plots were ploughed when the land was very dry in spite of a good rain which had fallen during the previous month.

The June plots were ploughed when the land was in excellent condition for that operation, while the condition of the ploughing for the September plots was fair.

The results obtained from the respective plots are shown below:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 8th May, 1931 — Variety—Nabawa. Seed—45lb. per acre — Superphosphate—112 lb. per acre.

Time of Ploughing.	Computed Yields per Acre. Sec. 1.		Sec. 2		Sec. 3.		Sec. 4		Sec. 5		Average Yields per acre, 1931		Percentage Yields 1931.	Average Yields per acre, 1928-31		Percentage Yields, 1928-31.
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%	bus.	lb.	%
Mid March	11	52	10	0	10	0	10	0	8	40	10	6	78	11	54	91
Mid June	14	24	13	4	13	20	10	40	13	12	12	56	100	13	2	100
Mid September	10	56	10	8	9	44	8	16	8	33	9	31	74	11	27	88

The results obtained this year, and the average results for the past four years, indicate that better results are obtained when the land is ploughed during the early winter months. Thus ploughing should be commenced immediately after seeding has been completed.

EXPERIMENTS ON "KOPI" SOILS.

Owing to the unsatisfactory crops of wheat generally obtained from the so-called "Kopi" soil in the Salmon Gums area, it was decided to conduct experiments with a view to obtaining definite information regarding crop response on this class of soil.

The Salmon Gums "Kopi" is described as a light-grey, highly calcareous soil. It is fairly powdery and resembles grey morrel soil of the Eastern Wheat Belt. With working, "Kopi" soil tends to compact down a little.

The vegetation includes giant mallee timber, this being a variety of Eucalyptus oleosa and is a member of the red morrel family.

The following experiments were conducted:—

Seasonal planting trial with wheat.
Seasonal planting trial with oats.
Fodder trial.
Manurial trial.

The land on which these experiments were conducted was disc ploughed to a depth of 3 inches during the previous June and springtyne cultivated during early October.

It was then harrowed after rain in December, and again in February and immediately prior to seeding.

Seasonal Planting Trial—Wheat.

The object of this trial is to determine the most suitable time to plant the very early, early, and midseason maturing varieties of wheat.

Accordingly the standard varieties Noongaar, Gluyas Early, and Nabawa were each planted in their respective plots during the months of April and May.

The results obtained are shown hereunder:—

SEASONAL PLANTING EXPERIMENT—WHEAT

April Planting.

Planted on 17th April, 1931. Superphosphate—112 lb. per acre. Seed—45 lb. per acre.

Variety.	Computed Yields per Acre										Average Yields per acre, 1931		Percentage Yields, 1931.
	Section 1		Section 2		Section 3		Section 4		Section 5				
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%
Noongaar	8	0	6	24	6	24	5	52	5	36	6	27	96
Nabawa	8	48	8	16	6	40	5	36	4	16	6	43	100
Gluyas Early	10	8	7	44	6	24	4	18	3	12	6	27	96

SEASONAL PLANTING EXPERIMENT—WHEAT

May Planting

Planted on 16th May, 1931. Superphosphate—112 lb. per acre. Seed—45 lb. per acre.

Variety.	Computed Yields per Acre										Average Yields per acre, 1931		Percentage Yields, 1931
	Section 1		Section 2		Section 3		Section 4		Section 5				
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%
Noongaar	6	40	5	4	4	0	4	32	3	44	4	48	95
Nabawa	7	44	5	52	4	16	4	0	3	28	5	4	100
Gluyas Early	5	4	6	24	4	16	3	28	4	32	4	47	95

These results, although for one year only, indicate the advantage of the early planting of wheat on this class of soil, even though the varieties may vary in the time of maturity. Very little difference in yield is indicated between the varieties.

Seasonal Planting Trial—Oats.

The object of this experiment is to determine the most suitable month to plant the early, midseason, and late maturing varieties of oats on this type of soil.

Accordingly the standard varieties Mulga, Guyra, and Algerian were each planted in their respective plots during the months of April and May.

The results obtained are shown hereunder:—

SEASONAL PLANTING EXPERIMENT—OATS

April Planting

Planted on 15th April, 1931. Superphosphate—112 lb. per acre. Seed—40 lb. per acre.

Variety.	Computed Yields per Acre										Average Yields per acre, 1931		Percentage Yields, 1931
	Section 1		Section 2		Section 3		Section 4		Section 5				
	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	bus.	lb.	%
Mulga	21	24	17	24	23	24	26	16	24	16	22	29	85
Algerian	25	8	25	8	26	32	24	32	32	0	26	32	100
Guyra	28	16	25	24	27	8	24	32	30	0	27	8	101

SEASONAL PLANTING EXPERIMENT—OATS.

May Planting.

Planted on 18th May. 1931. Superphosphate—112 lb per acre. Seed—40 lb. per acre.

Variety	Computed Yields per Acre					Average Yields per acre. 1931.	Percentage Yields. 1931.
	Section 1	Section 2	Section 3.	Section 4	Section 5.		
	bus lb.	bus. lb	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
Mulga ...	32 32	26 32	26 0	26 0	25 24	27 18	119
Algerian ...	26 32	24 16	24 16	19 8	20 0	22 38	100
Guyra ...	23 8	25 8	25 24	26 0	24 0	24 32	108

These results are for one year only, and therefore not conclusive. They indicate, however, that a suitable early variety planted in May yields as well as a later maturing variety planted in April.

Fodder Trial.

The object of this trial is to ascertain the relative yields obtained from the common fodder plants when planted on this type of soil.

The yields of the green fodders were ascertained by taking cuttings from quadrats of one square yard in area systematically through the respective plots. The yields are shown hereunder:—

FODDER TRIAL

Planted on 2nd May, 1931. Superphosphate—112 lb. per acre.

Fodder.	Rate of Seed per acre.	Computed Yield per Acre—Green Fodder.			Average Yields per acre, 1931.	Percentage Yields, 1931.
		Section 1.	Section 2	Section 3.		
	lb.	tons.	tons	tons	tons.	%
Noongaar Wheat ...	45	2·313	2·570	3 084	2·656	51
Mulga Oats ...	40	5 140	5·269	5 140	5 183	100
Cape Barley ...	60	4·626	5·564	4 112	4 797	93
Rye ...	40	4 369	4 626	4 369	4 455	86
Wimmera Rye Grass ...	4	5·911	6·168	6·939	6 339	122
Veldt Grass ...	4	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*

These results show that the highest yields of green fodder were obtained from the Wimmera rye grass. However, its growth in the early stages was slow, but it remained green longer than the others. It is therefore of most value as a late green feed.

For early feed, however, Mulga oats, barley and rye gave satisfactory results, and indicate their suitability for early green fodder. Of the three, Mulga oats gave the highest yield. The results from the wheat do not compare favourably with the oats, barley or rye.

The germination of the Veldt grass was so poor that comparative results could not be obtained.

Manurial Trial.

Unfortunately mice caused considerable damage by interfering both with the grain after planting and the young plants immediately after germination. This occurred on some plots more than others. In consequence, therefore, it has been decided that it would be inadvisable to use the results for comparative purposes. These results, therefore, have been discarded.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

MERREDIN EXPERIMENT FARM.

I. Thomas, Superintendent of Wheat Farms.
J. H. Langfield, Farm Manager.

In addition to the experiments published in the March issue of this Journal, the following experiments were conducted at the Merredin Experiment Farm during 1931:—

Fallow and non-fallow.

Time of ploughing.

The total rainfall for the year was 1,225 points, of which 912 points fell during the growing period (May to October). The following table shows the monthly rainfall, together with the average over a period of 20 years:—

	Jan.	Feb.	Mar	April	Growing Period.							Nov	Dec.	Total for year.
					May.	June	July.	Aug	Sept.	Oct	Total			
1931		54	4	191	218	115	197	257	81	44	912	24	40	1,225
Average 20 years .	52	56	119	85	135	191	189	145	92	73	825	43	54	1,234

The rainfall records indicate a fairly satisfactory season, good rains being recorded from April until the end of August. This, however, was largely offset by the very cold conditions during the winter months, heavy frosts being experienced during June, July, and August. Twenty frosts were recorded during June, the late frosts being less frequent. These cold conditions during these three months of the growing period greatly retarded crop growth, even the early maturing varieties making very slow growth.

Frosts also caused considerable damage to all varieties which came into ear during the early part of September. The disease "Takeall" also badly affected all crops sown in April.

Altogether, the season was not very favourable; disease was prevalent, while winter conditions were too severe to permit the usual vigorous crop growth.

The land on which these experiments were conducted originally carried salmon gum and gimlet timber, the soil being typical of such country. For some years the three-year rotation, namely, fallow, crops (chiefly wheat and oats), and pasture, has been practised.

Fallow and Non-fallow Experiment.

The object of this experiment, which has been conducted since 1925, is to demonstrate the advantages of fallowing.

Two plots, each one-quarter of an acre in area, were set apart for the experiment, one of which was left unfallowed and the other was ploughed 4 inches deep in June, 1930. The non-fallow plot was ploughed after rain in early April. Both the plots were then springtyne cultivated in April and again in May and disc cultivated immediately prior to seeding.

The results obtained are as follow:—

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 28th May, 1931 — Variety—Gluyas Early, Seed—45 lb per acre — Superphosphate—112 lb per acre.

Treatment.	Computed Yields per acre, 1931.		Percentage Yields, 1931	Average Yields per acre, 1925-31		Percentage Yields, 1925-31.
	bus.	lb.	%	bus.	lb.	%
Fallow	24	40	100	21	35	100
Non-Fallow	21	40	88	16	9	75

These results show definitely that decreased wheat yields can be expected when the land has not been fallowed.

The percentage results since 1925 illustrate the advantages of fallowing for the wheat crop.

Year.	Fallowed.	Unfallowed.
	%	%
1925	100	38
1926	100	58
1927	100	87
1928	100	44
1929	100	72
1930	100	104
1931	100	88
Average ..	100	75

Time of Ploughing Experiment.

A Time of Ploughing Experiment has been conducted at this farm for the past eight years, with the object of determining the effect of early and late winter fallowing on the resultant crops grown on heavy land. In the past six years (1924-29) the experiment consisted of two plots, each half an acre in area, one representing early winter fallow, being ploughed during the first week in June, and the other, late winter fallow, ploughed the last week in August. The average results over this period are distinctly in favour of the early winter fallow.

Time of Ploughing Experiment.

Average results, 1924-1929 (six years).

Time of Ploughing.	Average Yield per acre, 1924-29.		Average Percentage Yield per acre, 1924-29.
	Bus.	lbs.	%
First week in June ..	18	46	100
Last week in August ..	14	55	80

In 1930 the experiment was slightly modified, a third plot being included, the times of ploughing being respectively mid-June, mid-July, and mid-August, and the area of the plots each one-quarter of an acre. All plots were ploughed

to a uniform depth of 4 inches with a disc plough, the land being in good order when the June and July plots were ploughed, but was becoming hard when the August plots were ploughed, and hence turned up cloddy.

All the plots received the same subsequent treatment, being springtyne cultivated in spring, March and April, and were disc cultivated in May prior to seeding on 23rd May and harrowed after.

During the growing period it was noticed that the June and July ploughed plots were free from Takeall, whilst several patches of this disease were showing in the August plot. This fact has been observed in previous years.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 28th May, 1931. Variety Gluyas Early. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Time of Ploughing.	Computed Yields per acre, 1931		Percentage Yields, 1931	Average Yields per acre, 1930-31		Percentage Yields 1930-31
	bus.	lb.	%	bus.	lb.	%
Mid-July ...	22	12	95	22	30	88
Mid-June	23	20	100	25	40	100
Mid-August	17	32	75	18	54	71

The results are in conformity with the average results from the previous seven years and emphasise the advantage of early ploughing.

FIELD EXPERIMENTS WITH WHEAT, 1931.

Chapman Experiment Farm.

I. THOMAS, Superintendent of Wheat Farms.
F. L. SHIER, Farm Manager.

The following experiments, in addition to those published in the March issue of this Journal, were conducted at the Chapman Experiment Farm last year:—

Time of Ploughing.
Depth of Ploughing.
Mulching.
Fallow v. Non-Fallow.

The following table shows the monthly rainfalls as recorded at the farm during 1931, together with the averages over the past 26 years:—

	Jan.	Feb.	Mar.	Apl.	Growing Period: May	June	July.	Aug.	Sept.	Oct.	Total	Nov.	Dec.	Total for year.
1931 ...	...	.	12	61	459	241	486	273	200	96	1,755	125	56	2,009
Average, 26 years	17	42	67	63	241	441	367	247	170	99	1,598	32	26	1,841

The rainfall during the autumn months was very light, no rain of any consequence falling until the 3rd of May. From this date up to the 16th almost con-

tinuous rains were experienced, 453 points being recorded. In consequence seeding operations were delayed during that period. However, this was followed by a dry period lasting until the 8th of June, enabling crops to be planted under ideal conditions. Good rains were experienced throughout the growing period, 1,755 points being recorded from 1st May to 31st October.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment, which has been conducted for the past three years, is to ascertain whether the time of carrying out the initial operation of fallow, i.e. ploughing, has any effect upon the yields of the resultant wheat crop.

For the purpose of the experiment, three plots were required:—

Plot 1.—Ploughed in March (long summer fallow).

Plot 2.—Ploughed in June (early winter fallow).

Plot 3.—Ploughed in August (late winter fallow).

The plots, each one-eighth of an acre in area, were repeated five times.

The variety Nabawah was sown at the rate of 60 lb. per acre, superphosphate being applied at the rate of 112 lb. per acre.

The results obtained are as hereunder:—

TIME OF PLOUGHING EXPERIMENT

Planted on 20th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb per acre.

Time of Ploughing.	Computed Yields per Acre					Average Yields per acre, 1931.	Percentage Yields, 1931	Average Yields per acre, 1929-31	Percentage Yields, 1929-31.
	Sec 1	Sec. 2	Sec. 3.	Sec 4	Sec. 5				
	bus. lb.	bus. lb.	bus. lb	bus. lb	bus. lb.	bus lb.	%	bus. lb.	%
March, 1930	13 20	20 16	20 24	21 4	21 52	19 23	101	13 6	95
June, 1930	15 12	18 48	20 24	21 52	20 8	19 17	100	13 50	100
September, 1930 ..	20 32	20 0	21 4	20 24	18 48	20 10	105	13 26	97

The average results indicate that, although not to a great extent, the best returns are obtained from early winter fallow.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment, which has been conducted since 1915, is to determine the most economical depth of ploughing for wheat growing on fallowed land.

Three plots were required and were ploughed as follows:—

Plot 1.—4 inches, representing shallow ploughing.

Plot 2.—6 inches, representing medium ploughing.

Plot 3.—8 inches, representing deep ploughing.

The plots were each one-eighth of an acre in area and were repeated five times.

The land was ploughed with a mouldboard plough during June, 1930. It was springtyne cultivated during September and again immediately prior to seeding.

The results obtained are as follow:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 20th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb per acre.

Depth of Ploughing.	Computed Yields per Acre. Sec. 1	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre 1915-31	Percentage Yields, 1915-31.
	bus. lb	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus lb	%	bus lb.	%
4in. deep	20 56	21 20	19 28	*	16 40	19 36	102	15 24	99
6in. deep	21 4	20 32	19 12	*	15 44	19 8	100	15 29	100
8in. deep .	20 0	17 36	20 8	*	16 0	18 26	96	15 54	103

* Discarded owing to an error at seeding

The average results show that the most economical depth to plough this class of country is 4in. They also show that the yields are not decreased when the land is ploughed deeper.

MULCHING EXPERIMENT.

The object of this experiment is to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

The experiment has been conducted since 1914 and, as in previous years, the following system of cultivation was adopted:—

Plot 1 (well worked fallow).—Cultivated during spring, when required during summer after 25 points of rain or over and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2 (ordinary fallow—control).—Cultivated during spring and prior to seeding only.

Plot 3 (neglected fallow).—Cultivated prior to seeding only.

The land was ploughed four to five inches deep in July, 1930, with a mouldboard plough and the plots were cultivated as follows:—Plot 1 was cultivated in September, October, April and before seeding, i.e., four times. Plot 2 was cultivated in September and prior to seeding, and Plot 3 was cultivated before seeding only. All plots were repeated five times. The results for this year and the average results for 1930 are as follow:—

MULCHING EXPERIMENT.

Planted on 16th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb per acre

Treatment.	Computed Yields per Acre. Sec 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1914-31	Percentage Yields, 1914-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb	%
Cultivated in spring, after rains during summer and before seeding	18 24	17 36	16 40	16 0	16 8	16 58	105	14 55	107
Cultivated in spring and before seeding (Control)	17 52	17 20	16 0	14 40	14 40	16 6	100	13 54	100
Cultivated before seeding only	16 56	13 52	13 44	13 4	13 36	14 14	88	12 45	92

This year's results and the average results for the 17 years that the experiment has been conducted indicate that the most economical working of the fallow is to cultivate in spring and prior to seeding. It is pointed out, however, that where weeds are bad it is advisable to destroy them by cultivation at any time.

FALLOW AND NON-FALLOW EXPERIMENT.

The object of this experiment, which has been conducted for two years at this farm, is to ascertain the comparative effect upon the yields of the resultant wheat crop, when sown on fallowed and unfallowed land.

For the purpose of the experiment, two sets of plots are required, the fallow plots being ploughed with a mouldboard plough in July, 1930, and springtyne cultivated in September and prior to seeding, while the unfallowed plots were ploughed on 5th May, 1931, and harrowed prior to seeding, which took place on 20th May. The variety Nabawa was sown at the rate of 60lb. per acre and superphosphate applied at 112lb. per acre.

The plots in this experiment were larger than those in the other experiments, being three drill widths wide and 0.35 acre in area. The fallow plots were repeated three times and the non-fallow twice.

The results obtained are as follow:—

FALLOW *v.* NON-FALLOW EXPERIMENT.

Planted on 20th May, 1931 | Variety—Nabawa. Seed—60lb. per acre | Superphosphate—112lb per acre.

When Ploughed.	Computed Yields per Acre.					Average Yields per acre, 1931	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31
	Sec. 1	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5.				
	bus lb.	bus lb	bus. lb.	bus lb	bus lb.	bus lb	%	bus. lb.	%
Fallow ... ... Ploughed, June-July, 1930.	21 57	...	21 4	...	21 54	21 39	100	12 34	100
Non-Fallow .. ... Ploughed, May, 1931	...	16 0	...	17 7	...	16 34	77	10 50	86

Both in this year's results and the average results for the three years the experiment has been conducted, the fallowed plots show to advantage.

FIELD EXPERIMENTS WITH WHEAT, 1931.

DAMPAWAH EXPERIMENT FARM, PERENJORI.

I. THOMAS, Superintendent of Wheat Farms.
F. GISHUBL, Farm Manager.

The following experiments were conducted at the Dampawah Experiment Farm during 1931, in addition to those published in the March issue of this Journal:—

Fallow and Non-Fallow.
Time of Ploughing.
Depth of Ploughing.

The farm is situated 30 miles east of Perenjori, being formerly a portion of Karara Station on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered with York gum, giant mallee, karara, and mulga scrub.

This is the first crop grown on this land, which was cleared during 1929 and the early part of 1930. After the burn, as would be expected, a large quantity of ashes remained on the whole area.

During the winter months (July to August) of 1930 the land was ploughed three to four inches deep with a disc cultivating plough.

Owing to the subsequent dryness of the season no further working of the fallow followed until just at seeding time. Planting was done by means of a combined cultivator drill.

The following table shows the rainfall registered at the farm since it was established:—

—	Jan	Feb.	Mar	Apl	Growing Period							Nov	Dec	Total for year
					May	June.	July.	Aug	Sept.	Oct	Total			
1928 ..	*	*	*	*	164	94	238	142	71	34	743	6	156	†
1929 .. .	17	220	64	..	267	234	60	62	18	33	674	120		1,095
1930 . ..	.	..	93	123	48	404	160	93	22	41	768	31	54	1,069
1931	.	12	3	25	237	113	232	95	131	40	848	179	120	1 187

* No records † Incomplete.

Only 40 points were registered up to May, and this absence of early rains was not conducive to the preparation of a good seed-bed. Heavy rains fell during the early part of May, but these were followed by a dry spell lasting well into the month of June. This caused considerable anxiety for the germinating crops. However, good rains from the end of June to early October followed the dry spell.

Severe frosts were recorded from as early as May to as late as October. The earlier frosts had the effect of retarding crop growth, but better progress was made with the advent of warmer weather in early August. Towards the end of August, however, strong, hot winds affected the crops, blackening the flag and causing considerable concern for the crops just coming into ear.

The crops planted in May appeared to be the most affected. The rain which fell during September and early October appeared to revive these crops, but the affected patches were subsequently found to have produced but little grain.

FALLOW AND NON-FALLOW EXPERIMENT.

The object of this experiment is to ascertain the effect upon the resulting wheat crop of sowing on fallowed and unfallowed land.

For the purpose of the experiment two sets of plots were required. The fallow plots were ploughed in July, 1930, and the unfallowed plots on 14th April, 1931. The plots were sown on the 6th May with a combined cultivator drill.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The variety Gluyas Early was sown at the rate of 45 lb. per acre, superphosphate being applied at the rate of 90 lb. per acre.

The results are as hereunder:—

FALLOW V. NON-FALLOW EXPERIMENT.

Planted on 6th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre. Superphosphate—90lb. per acre.

Treatment.	Computed Yields per acre. Sec. 1.	Sec. 2.	Sec. 3.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930–31.	Percentage Yields, 1930–31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Fallow	8 48	8 48	9 44	9 7	100	10 22	100
Non-Fallow	8 16	7 44	7 28	7 40	86	8 57	86

The results show that the yields of the wheat crop are increased when grown on land which has been fallowed.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.* ploughing, has any effect upon the yield of the resultant wheat crop.

For the purpose of the experiment, three plots were required—

Plot 1.—Ploughed in April.
Plot 2.—Ploughed in June.
Plot 3.—Ploughed in August.

All plots were repeated five times.

Subsequent to ploughing, all plots were springtyne cultivated in August and prior to seeding, which took place on 5th May. The variety Gluyas Early was sown at the rate of 45 lbs. per acre and superphosphate applied at 90 lbs. per acre.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 5th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre. Superphosphate—90lb. per acre.

Time of Ploughing.	Computed Yields per Acre Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930-31.	Percentage Yields, 1930-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
March, 1930	7 12	7 20	8 8	8 8	8 8	7 47	90	10 30	95
June, 1930	9 52	7 28	8 0	8 48	8 56	8 37	100	11 5	100
August, 1930	8 32	8 8	8 32	9 36	9 44	8 54	103	10 38	96

From this year's results and the average results, which are for two years only, it would appear that the yields are increased when the land is ploughed during the early winter months. These are in conformity with the results of somewhat similar experiments conducted at the other experiment farms.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment, which was conducted for the first time last season, is to determine the comparative effects upon the resultant crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and they were ploughed in June, 1930, at the respective depths of 2in., 4in., and 6in., the whole experiment being repeated five times. The plots were planted with a combined cultivator drill on 6th May, the variety Gluyas Early being planted at the rate of 45 lbs. per acre and superphosphate applied at the rate of 90 lbs. per acre.

The results obtained were as follow:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1931 | Variety—Gluyas Early Seed—45lb. per acre. | Superphosphate—90lb. per acre.

Depth of Ploughing.	Computed Yields per Acre. Sec. 1	Sec. 2	Sec. 3	Sec. 4.	Sec. 5.	Average Yields per acre, 1931	Percentage Yields, 1931.	Average Yields per acre 1930-31	Percentage Yields, 1930-31.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
2in. deep ..	8 40	8 48	8 8	8 48	9 36	8 48	93	10 9	93
4in. deep ..	9 4	9 28	10 0	9 44	8 56	9 26	100	10 52	100
6in. deep ..	9 28	9 12	10 8	8 56	10 48	9 42	103	10 54	100

As the experiment has been conducted for two years only, no definite conclusion can be stated, but the results agree with experiments conducted at other experiment farms and indicate that it is most economical to plough to a depth of four inches.

50-ACRE FALLOW COMPETITIONS, 1931.

Judge : G. L. THROSSELL, Agricultural Adviser.

Fallow competitions were conducted during the past season by the Bruce Rock, Merredin, Nungarin, Phillips River and Karlgarin Agricultural Societies. Judging took place during February.

The scale of points, under which the awards were made, was as follows:—

Moisture	40 points.
Condition of Mulch	10 „
Freedom from Weeds	10 „
Consolidation of Seed Bed	20 „
Uniformity of Preparation	20 „
Total	100 „

BRUCE ROCK FALLOW COMPETITION.

Seven entries were inspected in this competition, one more than the previous year, the awards being as follows:—

BRUCE ROCK AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION

Table of Awards.

Competitor	District	Moisture, 40 pts.	Mulch, 10 pts.	Absence of weeds, 10 pts.	Consolidation, 20 pts.	Uniformity of preparation, 20 pts.	Total, 100 pts.
Smith C. and A. H.	Yalbarrin ..	35	9	9	19	19	91
Farrall, F. C. & Sons.	Yarding ..	36	8	9	19	18	90
Strange, P. A. (2) .	Yarding .	37	8	9	17	18	89
Brown, S. A. .	Bungulluping	35	8	9	19	18	89
Strange, P. A. (1)...	Yarding .	35	7	9	19	18	88
Smith, C. & Sons .	Yarding ..	34	7	9	18	18	86
Forster J. C. ..	Korbel ..	33	7	8	17	17	82

The competition was won by Messrs. C. & A. H. Smith, of Yalbarrin, whose entry was awarded 91 points. The land, which originally carried salmon and gimlet, was cleared in 1917 and has subsequently been worked on a two-year rotation, namely fallow—wheat. It was ploughed at the end of June, 1931, with a mouldboard plough to a depth of 3 inches, and subsequently cultivated with a springtyne cultivator at the end of August and early September, and rigid-tyne scarified in October. This fallow was very evenly prepared, the mulch being of desirable tilth and depth, and free of weeds.

The entry of Messrs. F. C. Farrall and Sons, of Yarding, was placed second with 90 points.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing Rains.				Spring Rains			Summer Rains.				Total, June–Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Bruce Rock ...	134	216	325	675	142	44	186	16	54	70	140	1,001
Yarding (Rosedale)	129	234	302	665	117	52	169	13	51	86	150	984

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS

Competitor.	Original Timber	When cleared	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points.
Smith, C. & A. H. ..	Salmon and gimlet	1917	2 years—Fallow Wheat	End June	Mouldboard	3in	Good	Springtyne cultivated in August-September. Rigid tyne scarified in October	91
Farrall, F. C. & Sons ..	Salmon, gimlet and mallee	1917 and 1913	2 years—Fallow, Wheat	June	Mouldboard and Disc	4in	Good	Half rigid tyne cultivated and balance disc cultivated in mid August. Springtyne cultivated in October and January	90
Strange, P. A. (2) ...	Jam, yorkgum and wattle	1911	3 years—Fallow, Wheat Oats	June	Disc	3 4in.	Good	Springtyne cultivated September	89
Brown, S. A.	Salmon, gimlet, and jam	1913	3 years—Fallow Wheat Oats	June	Rigid tyne scarifier	3in	Good	Rigid tyne scarified beginning and end September	89
Strange, P. A. (1) ..	Salmon, gimlet, yorkgum and jam	1911	Fallow Wheat Oats 2 years grazing	August	Disc	3 4in	Getting hard	Disc cultivated September-October. Portion springtyne cultivated mid January after rain	88
Smith, C. & Sons ...	Salmon and gimlet	1917	4 years—Fallow Wheat Oats Pasture	July	Disc	3in	Good	Disc cultivated August-September	86
Forster, J. C.	Salmon and gimlet	1912	3 years—Fallow, Wheat, Oats	July	Mouldboard .	4in.	Good	Rigid tyne scarified September. Harrowed end January	82

MERREDIN FALLOW COMPETITION, 1931.

For the 50-acre fallow competition conducted by the Merredin Agricultural Society there were nine competitors, an increase of one upon the previous year.

The rainfall recorded from June to January, inclusive, is shown in the table hereunder:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June–Jan.
	June.	July.	Aug.	Total.	Sept	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Merredin ...	128	253	268	649	107	68	175	42	49	72	163	987
Nukarni .	119	193	204	516	102	72	174	62	21	53	136	826
South Walgoolan	156	246	286	688	116	47	163	34	64	79	177	1,028
Hines' Hill ..	83	127	277	487	72	69	141	48	...	49	97	725

The awards are set out in the following table:—

MERREDIN AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	District	Moisture, 40 pts.	Mulch, 10 pts.	Absence of Weeds, 10 pts.	Consolidation, 10 pts.	Uniformity of Preparation, 20 pts.	Total, 100 pts.
Flockart, I. H. ..	Belka	34	8	9	19	19	89
Emmett, H. C. ..	Goomarin ..	35	7	9	18	19	88
Smallacombe, T. H.	Nangeenan ..	35	8	9	18	18	88
Teasdale, H. W. ...	Totadgin ..	35	8	9	18	18	88
McKenzie, P. C. ...	Hines Hill ..	35	7	8	19	18	87
Cook, W. T. ...	South Walgoolan	34	8	8	19	18	87
Zwar, A.	Nangeenan ...	35	7	9	18	17	86
Cockram, W. H. ...	Nukarni ..	32	9	9	18	18	86
Merredin Meat Co.	Merredin ..	33	7	8	18	17	83

The winner was Mr. I. H. Flockart of Belka, whose entry was awarded 89 points. Most of this fallow was ploughed with a skim mouldboard, the balance being done with a disc, during June. It was skim ploughed in August and cultivated with a combined cultivator-drill in October. Excepting that the mulch was a little shallow at the time of judging, this entry scored well.

Three competitors tied for second place, namely Messrs. H. C. Emmett, T. H. Smallacombe and H. W. Teasdale of Goomarin, Nangeenan and Totadgin respectively. These entries were each awarded 88 points.

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Original timber.	When cleared.	Rotation	When plowed.	Implement	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Flockart, I. H.	Gimlet, salmon ...	?	2 years—Fallow, Wheat	June	Skim mouldboard and disc	3in.	Good	Skim ploughed in August. Cultivated with combined cultivator drill in October	89
Emmett, H. C.	Gimlet, jam, mallee . .	?	3 years—Fallow, Wheat, Stubble	End July	Mouldboard . .	3–4in	Good	Tandem disced end July, springtyne cultivated September. Harrowed December and January	88
Smallacombe, T. H. ...	Salmon, gimlet ...	?	3 years—Fallow, Wheat, Stubble	July	Mouldboard and disc	4in	Good	Disc cultivated September. Springtyne cultivated in October	88
Teasdale, H. W.	Gimlet, tea-tree, salmon	1914	3 years—Fallow, Wheat, Oats	July	Mouldboard ..	3½in.	Good	Cultivated with combined cultivator drill early September, and with bridle draught scarifier early November after rain	88
McKenzie, P. C.	Salmon, gimlet, mallee	1912	2 years—Fallow, Wheat	July	Disc	4in.	Good	Tandem disced early August. Harrowed mid August. Springtyne cultivated end August	87
Cook, W. T.	Salmon, gimlet .	1924	2 years—Fallow, Wheat	June–July	Disc	4in	Good	Rigid tyne cultivated in August and September	87
Zwar, A.	Mallee gimlet, salmon, tea-tree	1913	2 years—Fallow, Wheat	July	Mouldboard ..	4in.	Boggy	Rigid tyne cultivated end September	86
Cockram, W. H.	Tea-tree, jam, mallee	1913	2 years—Fallow, Wheat	Mid-June	Disc .. .	3–4in	Good	Reploughed in August. Springtyne cultivated in October	86
Merredin Meat Co. .	Salmon, gimlet .	?	2 years—Fallow, Wheat	June	Disc . .	3in.	Good	Portion springtyne cultivated balance rigidtyne cultivated in August. Springtyne cultivated in January	83

KARLGARIN FALLOW COMPETITION, 1931.

The Karlgarin Agricultural Society conducted a fallow competition for the first time this year, the object being an endeavour to raise the standard of fallowing in the district. There were twelve competitors, the awards made being shown in the following table:—

KARLGARIN AGRICULTURAL SOCIETY.

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	Address.	Moisture 40 pts.	Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation. 20 pts	Uniformity of Preparation. 20 pts.	Total. 100 pts
Trestrail, Jas ...	Karlgarin .	32	8	9	18	18	85
Clayton, R. G .	Hyden Rock .	32	8	7	18	18	83
Read, A, C. ...	Karlgarin .	31	8	8	16	18	81
Grant, L. J.	Karlgarin .	31	7	7	18	18	81
Medcalf, C. W .	Karlgarin ...	32	7	7	18	17	81
Biglin, E. J. & D.	Karlgarin ..	30	7	8	18	17	80
James, S.	Karlgarin ..	31	7	8	17	17	80
Poole, H.	Karlgarin .	30	7	8	18	16	79
Linto, L.	Karlgarin .	31	7	6	17	18	79
Atkinson & Green	Hyden Rock .	29	7	7	17	18	78
Jones, J. T. .	Karlgarin .	30	7	7	17	16	77
Rae Bros. . .	Karlgarin .	28	7	8	16	17	76

This competition was won by Mr. James Trestrail, whose competing area was awarded 85 points. The original timber on the land fallowed was salmon, gimlet and morrel, which was cleared in 1925. It was ploughed with a disc implement in early August to a depth of 3½ inches, and received a cultivation with a rigid-tyne cultivator early in October.

Mr. R. G. Clayton, of Hyden Rock, obtained second place with an entry which was awarded 83 points.

The rainfall recorded from June to January inclusive is as follows:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June–Jan.
	June.	July.	Aug	Total.	Sept.	Oct.	Total	Nov.	Dec	Jan	Total	
Karlgarin ...	148	195	341	684	173	31	204	?	?	?		...
Hyden Rock ...	150	152	293	595	165	46	211	26	24	70	120	926

The cultural details of the competitors are summarised in the table hereunder:—

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared	Rotation	When ploughed	Implement.	Depth	Condition of land.	Subsequent cultivations.	Points awarded.
Trestrail, Jas.	Salmon, gimlet, morrel	1925	3 years—Fallow. Wheat. Stubble	Early Aug.	Disc	3½ins.	Good	Rigid tyne cultivated early October	85
Clayton, R. G. .	Mallee, salmon, gimlet	1929	Wheat. Wheat. Fallow	August	Disc . ..	3in.	Good	Re-ploughed September ...	83
Read, A. C.	Salmon, gimlet, morrel	1928	2 years—Fallow. Wheat	July	Disc .	3–4in.	Good	.. ..	81
Grant, L. J.	Salmon gimlet, mallee	1929	2 years—Fallow. Wheat	July–Aug	Disc .	3–4in	Good	Springtyne cultivated in August	81
Medcalf, C. W.	Gimlet, salmon, mallee	?	2 years—Fallow. Wheat	July–Aug	Disc	3–4in	Good	Springtyne cultivated in September	81
Biglin, E. J. & D.	Salmon, gimlet mallee	1930	2 years—Fallow. Wheat	End July	Rigidtyne scarifier	3in.	Good	Springtyne cultivated October	80
James, S.	Salmon, york, gimlet, mallee	1925	3 years—Fallow. Wheat Stubble	July	Disc .	3–4in	Good	Rigidtyne scarified in September	80
Poole, H.	Salmon, Morrel. gimlet	1927	2 years—Fallow. Wheat	End June	Disc . .	3in	Good	Re-ploughed August. Springtyne cultivated September and harrowed	79
Linto, L.	Morrel. salmon	1927	2 years—Fallow. Wheat	June–July	Disc . ..	3in	Good	Re-ploughed in August ...	79
Atkinson & Green	Salmon. gimlet. mallee	1930	.	July	Disc	3in	Good	Re-ploughed in August ..	78
Jones, J. T. .	Salmon, gimlet, mallee	1929	.	End July	Disc .	3in	Good	Re-ploughed in August ...	77
Rae Bros.	Scrub plain	1931	..	July	Disc .	3in.	Good	.. . .	76

The Karlgarin Agricultural Society is to be commended for its progressive step in inaugurating fallow competitions, and it is to be hoped that the result of this move will be an improvement in the quality of fallow prepared in the future, with the natural consequence of better average yields.

At the present time the need for improvement is very evident. The importance of ploughing the land thoroughly to an even depth of four inches, as early as possible in the fallowing period, cannot be over emphasised, although it is pointed out that, on soils of the morrel type, shallower ploughing is advocated on account of the difficulty in consolidation. Well prepared early fallow is one of the important factors in Take-all control, because the spores or seeds of this disease are induced to germinate when the infected fragments of the host plants are turned into the soil. If the fallow is kept clean and free of host plants the fungus will die.

The mulch on many of the fallows in this competition had a tendency to be too shallow, resulting in a drying out of soil moisture. It is important that a mulch of loose soil of a depth of at least 2½ inches should be maintained on the fallows over the summer months. It is preferred that the fallow should be cultivated with a tyned implement, either a springtyne or a rigid-tyne cultivator. The first working should be to the full depth of ploughing and across the original direction of the ploughing. The reason for this is to remove the irregularities of the ploughing, thus leaving as level a bottom as possible and also, because the tyned implements have a sifting or combing action, which brings the clods and larger soil particles to the surface and allows the finer particles to fall to the bottom. Should the condition of the land be such as to require other treatment in the form of disc cultivating or reploughing, the subsequent working should preferably be done with a tyned implement.

NUNGARIN FALLOW COMPETITION, 1931.

There was a considerable improvement in the number of competitors in the 50-acre Fallow Competition conducted by the Nungarin Agricultural Society, there being ten competitors, an increase of seven.

The rainfall recorded from June to January was as follows:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June–Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Nungarin ...	119	184	223	526	97	93	190	57	21	73	151	867
Mukinbudin ...	82	174	133	389	112	80	192	30	25	49	104	685
Mangowine ...	151	120	152	423	123	52	175	57	69	110	236	834

The awards made are as hereunder:—

NUNGARIN AGRICULTURAL SOCIETY.

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	Address.	Moisture. 40 pts.	Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Jolly, H. ...	Nungarin ...	34	9	9	18	19	89
Jones, D.	Nungarin ...	35	8	8	18	18	87
Creagh Bros., Ltd	Kwelkan ...	35	8	7	19	17	86
Manuel, C. J. ..	Mukinbudin ...	32	7	8	19	18	84
Williams, F. A. ..	Mangowine ...	35	7	6	19	17	84
Hoare, H. L. J. (1)	Burran Rock	32	8	9	18	17	84
Hodges, W. ...	Nungarin ...	31	7	9	18	18	83
Hoare, H. L. J (2)	Burran Rock ...	31	8	9	17	16	81
Clamp, A. J. ...	Mukinbudin ...	30	7	8	18	17	80
Fitzpatrick, R C ...	Nungarin ...	30	7	8	18	17	80

The entry of Mr. H. Jolly, of Nungarin, was placed first with 89 points. The original timber on this land was salmon, gimlet, and morrel. The land was ploughed in July, 1931, to a depth of 3-4 inches. It was harrowed in August and cultivated with a combined cultivator-drill in January, after rain.

Mr. D. Jones, of Nungarin, was placed second with an entry which was awarded 87 points.

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared	Rotation	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Jolly, H. P.	Salmon, gimlet, morrel	?	2 years—Fallow, Wheat	July	Mouldboard ...	3-4ins.	Good	Harrowed in August. Cultivated with a combined cultivator drill in January after rain	89
Jones, D.	Salmon, gimlet ...	1920	2 years—Fallow, Wheat	June	Disc	4ins.	Good	Springtyne cultivated August. Disc cultivated end September	87
Creagh Bros., Ltd. ...	Salmon, gimlet, mallee	1910	3 years—Fallow, Wheat, Stubble	August	Disc	4in.	Getting hard	Rigidtyne cultivated October	86
Manuel, C. J.	Salmon, gimlet ..	1922	2 years—Fallow, Wheat	June	Mouldboard ..	3½in.	Good	Springtyne cultivated August and September	84
Williams, F. A.	Salmon, gimlet, mallee, white gum	1924	3 years—Fallow, Wheat Oats	June	Mouldboard and disc	3-4ins.	Good	Rigidtyne cultivated end July. Portion springtyne cultivated	84
Hoare, H. L. J. (1) ...	Gimlet, salmon, morrel	1913	2 years—Fallow, Wheat	June-July	Mouldboard ...	4ins.	Good	Rigidtyne cultivated early August on gimlet portion. All cultivated mid September	84
Hodges, W.	Jam	?	”	June-July	Disc . .	3-4ins	Good	Re-ploughed August. Harrowed end September	83
Hoare, H. L. J (2) ...	Morrel, tea-tree, salmon and mallee	1913 and 1928	2 years—Fallow, Wheat	June-July	Mouldboard ..	4ins.	Good	Half uncultivated. Balance cultivated in late spring with a trip-tyne combined cultivator drill	81
Clamp, A. J.	Mallee, gimlet, and scrub	1930	2 years—Fallow, Crop	June-July	Disc	4ins.	Good	Harrowed after ploughing. Springtyne cultivated in August and September	80

Particulars of R C Fitzpatrick's entry not to hand.

PHILLIPS RIVER FALLOW COMPETITION.

There were six entries in the Fallow Competition conducted by the Phillips River Agricultural Society, Ravensthorpe. The competition was judged early in December, somewhat earlier than the other fallow competitions, but advantage was taken of my visit to the district, in connection with judging crop competitions, to carry out this work.

The rainfall recorded from June to December was as follows:—

—	Winter Rains				Spring Rains.			Summer Rains			Total June to December
	June	July	Aug	Total	Sept	Oct	Total	Nov	Dec	Total.	
Ravensthorpe	157	163	441	761	183	45	228	105	29	134	1,123
Mt Short ..	134	124	372	630	175	38	213	77	30	107	950

The awards are shown in the following table:—

PHILLIPS RIVER AGRICULTURAL SOCIETY

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor	Address	Moisture 40 pts.	Condition of Mulch 10 pts.	Absence of Weeds 10 pts.	Consolidation 20 pts.	Uniformity of Preparation 20 pts.	Total. 100 pts.
Love, N. S.	Ravensthorpe	36	8	8	19	18	89
Barrett Bros	Mt Short	36	8	6	18	19	87
Campbell, J .	Mt Short	35	8	8	18	17	86
Bebbington Bros	Mt Short	36	7	7	18	17	85
Chambers Bros	Ravensthorpe	34	8	8	17	18	85
Ware, J. H. ..	Ravensthorpe. .	32	7	7	16	16	78

The fallow entered by Mr. N. S. Love, of Ravensthorpe, was awarded first place, with a total of 89 points. The land originally carried salmon and manna gum, which was cleared in 1928. It was ploughed during the end of June and early July with a mouldboard plough to a depth of four inches and subsequently was cultivated with a springtyne cultivator in October. There was a little weed growth present, which could have easily been controlled by sheep, and the mulch was not quite deep enough in places.

Messrs. Barrett Bros. were awarded second place, their entry scoring 87 points.

A very considerable improvement was noted this year in the quality of the fallow in this competition.

The cultural details are as hereunder:—

CULTURAL DETAILS

Competitor.	Original Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Love, N. S.	Salmon and manna ...	1928	2 years—Fallow. Wheat	June–July	Mouldboard ...	4ins.	Good	Springtyne cultivated in October	89
Barrett Bros.	Salmon and mallee ...	1928	Wheat, Oats, Fallow	June–July	Disc	4ins.	Good	Springtyne cultivated early August and mid October	87
Campbell, J.	Jam, mallee, salmon and gimlet	?	3 years—Fallow, Wheat. Stubble	June	Mouldboard ..	3–4ins.	Good	Springtyne cultivated August and end September	86
Bebbington Bros. ...	Mort, gimlet, and mallee	1928	3 years—Fallow, Wheat, Stubble	June	Mouldboard and Disc	3½ins.	Good	Springtyne cultivated end August and again November after rain	85
Chambers Bros.	Mallee, salmon, and gimlet	?	3 years—Fallow, Wheat, Stubble	June–July	Mouldboard ..	4ins.	Good	Springtyne cultivated beginning August	85
Ware, J. H.	Mallee	1924	?	End June	Mouldboard ...	3ins.	Good	... ...	78

OAT VARIETY TRIALS IN THE SOUTH-WEST.

G. K. Baron-Hay, Superintendent of Dairying.

Oat Variety Trials have been conducted in the South-West for a number of years by officers of the Dairy Branch and were continued during 1931.

At Noggerup the experiment was conducted on the property of Mr. A. Smith, McAlinden. The results, as reported by Mr. M. Cullity, Agricultural Adviser, are as follow:—

Soil.—Light sand to sandy loam and gravelly. Ploughed for first time for this trial.

Cultivation.—Ploughed twice and harrowed twice. The seed and fertiliser were drilled in on 22nd May.

Rate of Seeding.—70 lb. per acre.

Fertiliser.—160 lb. per acre.

Subterranean clover burr was sown after the oats were drilled in, and the establishment was successful.

Yields are shown in the following table:—

Variety.	Planted.	Yield. (Average of 3 plots.)			Percentage Yield.
		cwts.	qrs.	lb.	
Algerian	May 22nd	19	1	24	100
Guyra	do. ...	16	2	22	86
Lachlan	do. ...	16	0	17	83
Burt's Early	do. ...	14	1	19	74
Mulga	do. ...	13	3	11	71

The above shows that, as a hay crop, "Algerian" is the most successful hay oat, while "Guyra" and "Lachlan" are better than "Burt's Early" and "Mulga." The two latter, however, were noted to grow rapidly in the early stages and were valuable as a source of early green feed.

The average results of 20 trials conducted throughout the South-West are shown in the following table:—

Variety.	Yield. Average- 60 plots = 20 Trials.				Percentage Yield.
	tons.	cwts.	qrs.	lb.	
Algerian	2	8	3	13	100
Guyra	2	3	2	4	89
Lachlan	2	2	3	9	86
Burt's Early ...	1	14	2	0	71
Mulga	1	14	0	6	70

This indicates that for a hay crop "Algerian" has proved more suitable than other varieties, but in almost all centres the officers conducting the experiments noted that for early grazing "Burt's Early" and "Mulga" were preferable, and that the fodder provided by these varieties was more relished by stock than that of "Algerian."

REPORT ON DEPARTMENTAL EXPERIMENTAL PLOTS, PERTH.

C. A. GARDNER, Government Botanist.

G. R. W. MEADLY, B.Sc., Agricultural Adviser.

Last year a series of experiments was commenced with various fodder plants in order to test the suitability of introduced plants under local conditions, compare various strains and forms of pasture plants, particularly with regard to permanence, and also to provide examples of different species for those who are interested in seeing them under cultivation.

The ground was obtained for the experiments in September, 1930, and consists of an area of about one-sixth of an acre situated near the Government Gardens Nursery. The soil is a grey sand which becomes loose on the surface during summer. Owing to the water table being high in winter, a number of tile drains have been constructed at a depth of about two feet. The average depth of the summer water table is about 3 feet.

A general fertiliser consisting of superphosphate, sulphate of ammonia and potash in the proportion of 10—2—1 was used on all the plots.

The rainfall for the period under consideration, along with the average over 55 years, is given in the table below:—

From Jan 1 to end of—	Mar	Apl.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.
Average .	154	493	822	1,526	2,196	2,866	3,113	3,332	3,412	3,470	34	76	154	322
1931-32 ...	97	278	1,122	1,776	2,565	3,249	3,776	3,878	3,881	3,918	19	19	36	352

The following is a brief outline of observations carried out during the last season:—

RYE GRASSES.

A series of ten Rye Grasses ranging from True Perennial through Good False, Average False, and Bad False to Dominant Italian were obtained from the New Zealand Department of Agriculture. Owing to the large amount of discussion recently regarding so-called "pseudo-perennials," the manner of growth and period of survival of the above types were followed with interest. All these Rye Grasses were planted 25th-26th May.

True Perennial.—Carried over to produce good turf with fairly even growth.

Good False.—Early growth comparatively slow, but remained green and produced a fair sward.

Average False.—The two plots showed considerable variation. One (P2094) gave growth equivalent to that of the poorer of the true perennials. The other was of average growth, but only half survived and remained green.

Bad False.—In one plot a few plants survived, but the other died completely.

Dominant Italian.—Both plots showed out well early, but one died out while the other remained green to form a fair mat.

A number of other perennials were also tried. Of these the most outstanding was the New Zealand Certified (P2133), which made good growth early, carried through the summer months, and is now coming away well, giving a fine even sward.

The Maiden (Leiston Grown, P2135), and the Certified Maniototе (P2136) gave excellent early growth of a flat and even type, but, along with a sample from the Waite Research Institute (P2072), died out during the summer.

A line from America (P2138), received as Perennial Rye Grass, had the morphological features of a "pseudo-perenne" mixed with Italian, and died out early.

Two samples from Scotland (P2137), and Czecho-Slovakia (P2126), remained green over about half the plots.

The above results emphasise the importance of purchasing a good line of seed in order to obtain a satisfactory degree of permanence and growth production.

Wimmera Rye Grass

A number of different lines were tried out and all dried off fairly early in summer. The McDougall strain (P2134) showed strong growth early and was the outstanding plot. Good natural reseeding has occurred in the majority of the plots and the young seedlings are now making excellent progress.

The Dominant Italians and Wimmeras showed out earlier than the perennials, but generally died out, while the perennials were still producing new growth.

All the plots were cut several times during the season and generally good regrowths occurred.

The Perennial Rye Grasses from New Zealand, particularly the Certified Seed, gave the best results, while the McDougall strain of Wimmera was the most outstanding of that species.

CANARY GRASSES.

On 26th May, 14 plots of *Phalaris spp.* were planted. Early in August *P. minor* was showing more growth than *P. canariensis*, which was little superior to *P. tuberosa* in this respect. The two most advanced perennials were, at this stage, P2074 and P2077 (both from the Waite Research Institute). These were of more erect habit than the remainder of the same species.

By the end of November all the *P. minor* and *P. canariensis* had reached the seeding stage and were drying rapidly, while the *P. tuberosa* plots were very green and producing flowering spikes. During the second week of December all the Canary grasses were cut. *P. minor* and *P. canariensis* showed no recovery at all and quickly died out. The perennials, however, soon showed up again and, at the end of January, were quite vigorous and of a healthy green colour.

The most outstanding plot at this stage was that derived from Victorian (Beaconsfield) Seed (P2148). This was closely followed by P2149, P2146, and P2147, which were obtained from New Zealand, U.S.A. (Harding Grass), and Victoria respectively. The four samples of *P. tuberosa* from the Waite Research Institute (P2074—P2077) were all green and showing good growth. By the end of April all the perennials were making good growth (4—6in. high), particularly those from the Waite Institute. The line received as *P. nodosa* (P2080), which is now regarded by most botanists as being *P. tuberosa,* appears to be at least a variety of that species on growth form. The leaves are narrower and the vegetative features give it a more hardy appearance. P2146 was introduced as *P. stenoptera,* but as yet no difference can be found between this and *P. tuberosa*, despite the fact that recently it has again been declared an authentic species in America.

It is interesting to note that seed introduced from South America as *P. tuberosa* was really typical *P. minor.* Although a good form of the annual species, this demonstrates the care which must be exercised when purchasing Toowoomba Canary

Grass. Besides being an annual which would probably be detrimental to a permanent pasture, the seed of *P. minor* is much cheaper than that of *P. tuberosa.*

Results so far indicate that *Phalaris tuberosa* is likely to become one of our most important perennial grasses, especially for the drier parts, particularly if more hardy strains can be derived. Experience shows that this grass must be free from much competition in the earlier stages of its establishment, either in the form of other fodder plants or weeds.

The annual species, *P. minor* and *P. canariensis,* were comparatively short-lived, the former making better initial growth and providing early feed.

RED CLOVERS.

At the beginning of June the following lines of Red Clover were planted:—

P2099—Montgomeryshire.
P2100—English Late Flowering.
P2101—American Mammoth.
P2102—Czecho-Slovakian.
P2103—Italian Mammoth.
P2104—Hungarian.
P2105—English Early.
P2141—Sutton's Late Flowering.
P2190—Baltimore Mammoth Red.

The germination in each case was good and generally the growth was of a high standard, producing a considerable amount of bulk. Throughout practically the whole of the season the outstanding plot was that of the Italian Mammoth. This showed excellent growth early, responded well after cutting, and with little doubt produced more bulk than any of the other plots.

The final cut was made on 4th February when the four best plots, viz., Italian Mammoth, English Late Flowering, Hungarian and Czecho-Slovakian were all above two feet in height.

Not one of the plots carried over the summer months, but this may have been due to the fact that the final cutting was delayed for a specific purpose. These plots will shortly be replanted and every opportunity afforded them to perennate.

WHITE CLOVERS.

The following plots of White Clover (*Trifolium repens*) were planted at the beginning of June:—

P2106—Suttons' Wild White.
P2107—English White Dutch.
P2108—English Wild White.
P2109—Kentish Wild White.
P2110—Lodi Mammoth White.
P2111—New Zealand White.
P2112—English Giant.
P2152—New Zealand Certified Wild White.

The first to show out were the English White and New Zealand White, while the New Zealand Certified Wild White gave a good germination but yellowed slightly owing to the cold.

The Wild Whites were slower in their early growth but produced an even turf of a healthy green nature.

Only two of the plots carried over the summer months, the English Wild White remaining practically dormant until the first rains and then making rapid growth. In the other surviving plot, the Kentish Wild White, only one plant remained.

These clovers received severe competition from weeds during the earlier part of their growth, and this season they will be resown under more favourable conditions.

LUCERNES.

Only two plots were planted, viz., Hunter River (P2188) and an introduced line (P2187). Both germinated well but the Hunter River was superior in every way, producing a greater bulk, recovering quicker after cutting, and being of more even growth.

MISCELLANEOUS GRASSES.

Cocksfoot (*Dactylis glomerata*).—Two lines of Cocksfoot, Welsh (P2167), and New Zealand Akaroa (P2168), were planted on 24th June. By the middle of August both plots were showing up well, but it soon became evident that the Welsh strain contained a considerable amount of Yorkshire Fog (*Holcus lanatus*). Several cuttings were made during the year and the Akaroa responded quicker than the Welsh, generally giving a more dense and vigorous type of growth.

Waipu Brown Top (*Agrostis tenuis*—P2166).—This grass was planted on 24th June and gave an excellent germination, producing a fine even mat. During the summer, when the sand was very loose, sheep, in grazing, pulled up a number of plants and generally disturbed the plot, which carried over with difficulty.

Tall Oat Grass (*Arrhenatherum elatius*—P2118).—Planted at the end of May the Tall Oat Grass proved to be one of the most outstanding plots in the trials. By August it was making exceedingly good growth of a flat type well adapted for grazing. Several cuttings were made, the grass remaining green throughout the summer and is now producing soft dense foliage.

Red Fescue (*Festuca rubra*, var *genuina*—P2119).—This grass made only ordinary growth and appears to be most suited as a foundation grass, particularly for playing greens, as the growth is of a very fine nature.

Crested Wheat Grass (*Agropyron cristatum*—P2121).—Gave fair germination producing plants of a spreading habit, the majority of which carried over the summer and are now renewing their growth.

Pinnate Brome (*Bromus pinnatus*—P2123).—Produced fair growth, about two-thirds of the plot carrying over the summer.

Trisetum flavescens—P2132.—Made fair growth early but died out during the summer.

Pennisetum maximum.—Roots of this grass were introduced from South Africa and made rapid growth, producing plants 3—4ft. high. It appears to be very hardy, and if kept closely grazed should be a useful fodder plant. When allowed to grow freely, however, it tends to become wiry and harsh.

Woolly Finger Grass (*Digitaria eriantha*).—Although the roots obtained from South Africa appeared to be quite dead on arrival, green shoots have now been formed, and there is every indication that the grass will make satisfactory growth. Despite several other attempts to establish Woolly Finger Grass in Western Australia, this is the first time, to our knowledge, that this object has been achieved. It is a highly valued grass in South Africa, but, owing to the non-production of seed there, all dissemination is done by means of roots.

MISCELLANEOUS LEGUMINOUS PLANTS.

Scented Clover (*Trifolium suaveolens*—P2151).—Gave good germination and produced an abundance of growth during the earlier part of the season. This clover is somewhat similar in habit to Red Clover, but is an annual with less leaf surface and large hollow stems. None of the plants produced any seeds.

Sulla (*Hedysarum coronarium*—P2129).—Germinated fairly well, but did not make much growth, possibly due to a lack of the correct inoculating bacterium in the soil. The two plants which carried over the summer formed a substantial root stock and are now looking green and healthy.

Birdsfoot Trefoils (*Lotus spp.*).—Four plots, three of *L. uliginosus* (P2142—P2144) from different sources, and one of *L. corniculatus* (P2127) from France, were sown. The germination of the *L. uliginosus* generally was poor, and a considerable percentage of the plants consisted of annual species, *L. hispidus* and/or *L. angustissimus*. None of these showed up to any advantage.

On the other hand, the *L. corniculatus* germinated well and made excellent growth, particularly during the summer. A strong rooting system was formed and good re-growth made after cutting; in fact, this was probably the most outstanding summer plot in the experiments.

A number of annuals, including a Lentil (*Lens esculenta*—P2155), Cicer Pea (*Cicer arietinum*—P2156), and *Astragalus falcatus*—P2128) were also grown.

MISCELLANEOUS.

Yarrow (*Achillea millefolium*—P2113).

Sea Rib Grass (*Plantago maritima*—P2116).

Sheep's Burnet (*Poterium sanguisorba*—P2117 and P2191).

Sheep's Parsley (*Petroselinum sativum*—P2114).

All these plots germinated well and remained green right through the summer.

Plantago maritima made comparatively slow spring growth, but came away excellently during the summer and was kept closely grazed by sheep.

The Sheep's Burnet held out well till the end of January, when about half died. The remainder made good growth after the first rains and is now doing well.

The Yarrow and Sheep's Parsley both made rapid growth and produced a considerable bulk of feed. These two plots at no stage lost their healthy green colour and when grazed were well eaten back by sheep.

HINTS ON BEES AND THEIR MANAGEMENT.

H. Willoughby Lance, Apiculturist.

Success in beekeeping depends on many factors. To be successful, a bee-keeper must take to it naturally, from a love of the bees and interest in their work. He needs patience and a capacity for taking pains and working systematically. He should study the flora of his district and know when the various flowers and trees may be expected to blossom.

His hives should be strong, well-made and well-kept, The bees should be of a good race and strain, and strong in numbers.

Hives—

Box hives without frames are useless for the gathering of honey and are not allowed under Section 12 of the Bees Act, 1930. They cannot be examined and are breeding places for disease and moth.

Some men have standard frames and hives, but have neglected to put wire and foundation into the frames, and the expenditure on frames is worse than useless, as the bees have built the combs anyhow across the frames, which cannot be removed without breaking the comb. Sometimes the frames are fitted with starters or even full sheets of foundation, but owing to the hives not being level the frames do not hang plumb and the combs are built across two frames or, due to the hereditary tendency of some bees to build irregular comb, the combs are built anyhow, and the expenditure and labour are useless.

Another type of hive is the home-made one with incorrect spaces due to the ignorance or indifference of the owner to the habits and methods of bees.

In some of these hives the covers and frames are stuck so tight with propolis that they break before they can be removed, or there is so much unnecessary space, that there is extra comb which has to be broken or cut before the cover or frames can be removed. Beekeepers should remember that the natural working space of the bee is ¼ inch. If the space is less than 3/16th of an inch, the bees will fill it up, if more than 5/16th of an inch, they will probably build comb therein.

A previous issue of the Journal contained an article on "Bee Hives." This has been reprinted in leaflet form and can be obtained from the Department of Agriculture. The number is 308. It contains particulars and sketches of a home-made hive including a cover or roof which is cheap, and more serviceable than most of those seen about apiaries.

Transferring—

Many small bee-keepers without much experience find it difficult to transfer bees from box hives to frame hives, or from frame hives with a mass of cross combs to new frame hives. For their benefit, I will give hereunder particulars of how best to do this.

The transfer should take place, if possible, while there is honey coming in, but it may be done at any time provided the bees are fed plentifully after the transfer has taken place, with sugar or honey syrup. The easiest way of feeding is to obtain a press-top tin, such as is used for honey or golden syrup. Punch a dozen or two small holes in the lid and fill with the syrup.

A quilt made of ticking, sacking, or similar material should be placed over the frames and a hole cut in the centre not larger than the size of the tin. The tin of syrup may now be inverted over the hole; the bees will then suck the syrup

through the holes. An empty super or box should then be placed on top to cover the tin and the cover of the hive replaced. At least eight or 10 lbs. of syrup should be given to each hive to enable the bees to build the new comb and lay up a store for breeding.

A syrup may be made for this purpose from sugar, using 10 lbs. sugar, 5 pints water, 1 oz. vinegar, ½ oz. salt. Boil for a few minutes and feed to the bees whilst warm. To make honey syrup, dissolve about 2 parts of honey in 1 part of water. If honey is used, the bee-keeper should be quite certain that this does not come from a hive that may have disease, as honey is the principal carrier of foul brood.

To transfer bees from old box to new hive, take the box hive and place on the ground upside down so that the bottoms of the combs are exposed, place bricks or blocks of wood under one end of box to give a slope; place new hive fitted with frames and full sheets of foundation on an empty box so that front edge of floor touches the highest end of box hive; draw body of new hive forward to project over floor about 1½ inches.

Drum sides of box and give a little smoke at lowest end. Bees will then run up highest end of box on to floor of new hive. When nearly all the bees are out the combs of honey can be cut out, some of which should be fed back to the bees after they are in their new hive; the combs of brood should be tied with string into frames and put into centre of new hive.

To transfer bees from hive with cross combs.—The method adopted may be similar to that with box hives, but in this case it will be impossible to cut out the combs of brood, and tie into frames. It should therefore not be adopted unless the hive is very strong with bees and there is a good honey flow.

Another method which may be adopted with both box hives and hives with cross combs, when the above are not suitable or easy, is to place the box or old frame hive on top of a new hive fitted with frames and full sheets of foundation, making sure that the only entrance is through the new hive.

As the brood in the old hive hatches out and honey comes in, the bees will fill the empty cells with honey and force the queen down into the new hive. When upon examination it is found that the queen is in the bottom, or new hive, a queen excluder should be placed over it to prevent her again going to the top box. Four weeks later all brood in the top box will be hatched out, and it may then be removed.

The drawback with this method is the time it takes, as the queen will not be forced down until there is plenty of honey coming in.

Bees.

In all primary industries the importance of not only having the best breeds of either seed or livestock, but also of having the breed most suitable to the conditions of the district, has never been so fully realised as at the present time.

In view of this generally acknowledged fact of the importance of good blood, it is surprising to find a large number of bee-keepers who appear to be indifferent to it. In going about the country, one finds very few men who have a really first class bee: they may have a few good colonies, but they do not breed from these, nor do they purchase new pure bred queens. They let nature have its way, allowing the bees to swarm and to re-queen themselves. This method in bee-keeping, as with poultry or any other live stock, tends to the deterioration of the stock.

Selection and breeding from selection is the only way to get the best results, reduce production costs, and enable the farmer, be he bee-farmer or other, to meet competition and earn a comfortable living.

Of course this is not the only factor upon which success depends. The general method of conducting the work of the farm is most important, and then there are so many factors over which the farmer has no control, such as the weather, forest fires, etc. This, however, is a certain fact, that in a good season, with a good honey flow, any colony of bees that is fairly strong, will probably do well, even if badly neglected by the owner. But when circumstances are against the industrious bee everything depends upon the strains from which the bees have been bred. Bees from a good stock will survive and perhaps store a surplus, while the indifferent ones will go under. Practically all successful beekeepers are careful to re-queen every colony at least every two years, and some every year, or even less if the queen does not deliver the goods.

Some of them breed their own queens from their best colonies, others consider that it pays them better to concentrate on honey production and leave the queen breeding to the expert.

The Department, recognising the importance of good stock, has imported Italian queens from Italy, and Carniolans from Jugo-Slavia, and queens bred from these can be obtained from the Department of Agriculture.

It is claimed for the Carniolan that they are a longer lived bee than the Italian, that they are hardier and will work in weather that keeps the Italian at home, and that they build beautiful white comb and are quiet to handle.

A longer lived bee means a smaller proportion of brood to that of adult bees than would be the case with short-lived bees. That, again, means less food to be consumed by the nurse bees to make chyle food for the larvae. It is usually considered that the life of the average worker bee during the honey season is about six weeks. Assuming that we can obtain workers that will live eight weeks instead of six, we shall save 25 per cent. of the food required for brood raising. For instance, assume that we have a hive of 30,000 bees with our average bee. This would require the hatching of 5,000 bees per week to keep up the population of the hives or 120,000 bees in six months. With a bee living eight weeks, only 3,750 bees would require to be hatched per week, or 90,000 in six months instead of 120,000. We thus realise what an immense saving there would be in food. Leaflet No. 331, dealing with the "Carniolan Bee" can be obtained free from the Department.

Winter Stores.

Many beekeepers who read these notes, do not carefully examine their hives at the close of the summer and ascertain that they have plenty of winter stores. Any such I would advise to at once go through their hives, lifting each one to ascertain the weight, and if any are light, mark these, and then on the first warm, sunny day open them carefully, disturbing the bees as little as possible. Examine the outside combs and see how much honey there is. The amount required varies with the district. In most cases a fairly strong colony should have enough honey to fill at least two full-depth combs; a really strong colony three or four, in addition to the honey on the broodcombs. It has to be remembered that bees consume a large amount of honey when brood-rearing. Very often a few warm spring days will start brood-rearing, then a spell of inclement weather sets in and the bees use up their last reserve of stores to feed the young larvae, and cannot get any more to replace it. Also much of the young brood gets chilled and dies. Then when honey weather sets in again there is delay in breeding until there is fresh store in the larder both of honey and pollen.

If there is little or no honey, the bees should be fed at once with honey syrup or, failing this, sugar syrup. With an average thick honey, about two-parts of honey to one of water is a good proportion. See that all the honey is dissolved and mixed with the water. Give this to the bees warm. There are many good feeders on the market, particulars of which can be obtained from any catalogue of bee goods. Failing one of these, a good home-made feeder is shown in Figure 1. The box is about 6in. x 4in. x 3½in. deep, a division is placed one inch from the end, the bottom only extends to this, thus having an entrance from the bottom, one inch wide. The top of the box consists of a piece of glass which slides in from the end,

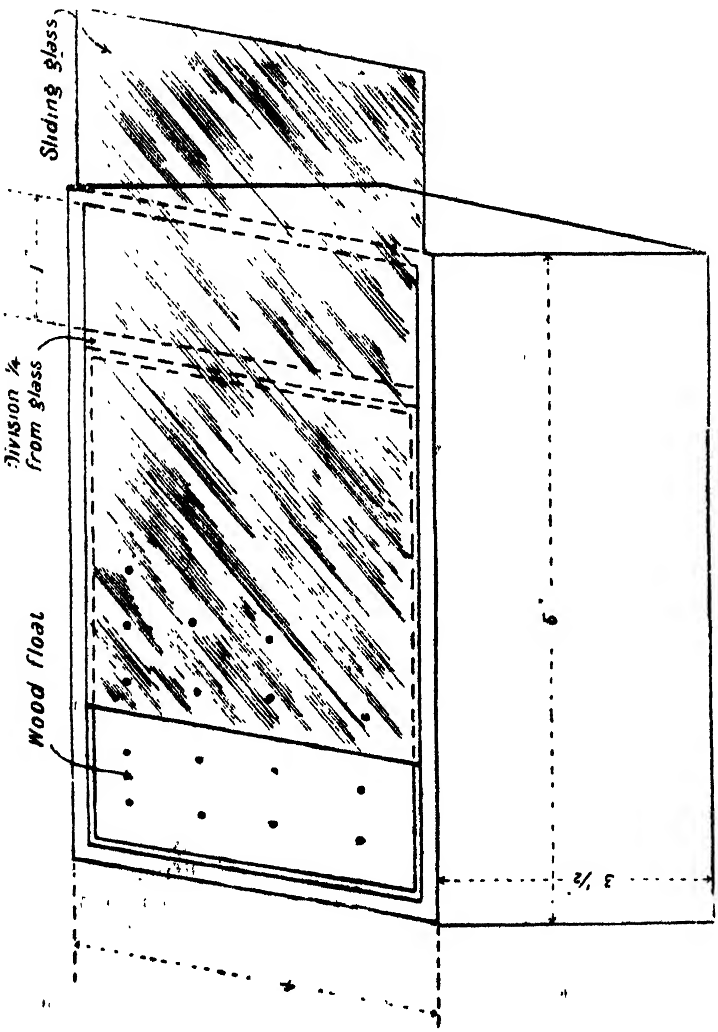


FIG. 1.

a space about ¼in. must be left between the top of the wood division and the glass. A piece of thin wood is now cut about ⅛in. smaller, each way, than the inside of the box, and a number of small holes bored therein. The box is filled with syrup, and a piece of wood acts as a float from which the bees feed, coming up through the inch space, extending over the division on to the float.

The advantages of this feeder are that it can be seen when it is empty, and can be refilled without removing from the hive. The inside may be filled with hot wax, swilled round and emptied out. This will make joints honey tight. If the matter is urgent and the beekeeper has not time to make the above, an effective feeder can be made by punching small holes in the top of a press-top tin, which after filling is inverted on to a plate and placed on top of the frames inside a spare super box; or a quilt from some strong material can be put over the frames, a hole cut in the centre, and the inverted tin placed over the hole. This method has the advantage that, during cold weather, the brood nest is kept warmer than with the plate method. If any colonies are weak, only covering a few frames, entrances should be closed to two or three inches.

As soon as the spring really sets in all hives should be examined, as it is a most important time for beekeepers. Hives should be cleaned and faulty ones replaced. (See notes in the *Journal* for June, 1928.) The brood nest should be examined, and if the queen is old and failing, the hive should be marked for re-queening at the earliest possible date. The amount of honey stores should be noted and, if necessary, colonies should be fed. If a colony is short of pollen, make a note of it, and later a hive may be found that can spare a comb of this most important food for the young bee, as no breeding can take place without it.

Dr. E. F. Phillips, in "Beekeeping," estimates that an average strong colony of bees consumes 480 lbs. of honey per year, divided as follows:—Maintenance of bees 400 lbs., feeding of brood 70 lbs., wax production 10 lbs.

Strong Colonies.

The first object of all beekeepers should be to build up strong colonies. The aim should be two 10-frame body boxes boiling over with young bees. I still find that the aim of many beekeepers is to make a show with a large number of hives, perhaps thinking that means a lot of honey. No greater mistake can be made. A lot of hives frequently means no honey. Whereas a few strong hives mean plenty of honey and less work. This is realised to such an extent in the United States of America and England that many beekeepers are using 12-frame hives with deeper frames. At the present stage of beekeeping here, I do not recommend this, except in special cases, with experienced beekeepers, but advise every beekeeper to aim at two full-depth bodies packed with bees. Then with a good honey flow such colonies will fill two or even three honey supers. A good well-bred queen can easily keep these filled with brood during an average season. Cull your queens, and if you have any duds replace them with good stock. Who would be content with a hen that laid one egg per week when he can have one that will lay six or seven? Yet that is what many beekeepers have in the way of queens, those that lay only four or five hundred eggs per day instead of one or two thousand.

Re-Queening.

I am often asked how to re-queen, so I will give a few notes here on the matter. Of course, the first thing to do is to catch and kill the old queen, otherwise the young one will undoubtedly be killed. The usual process is to lift out the combs one by one and examine until the queen is found. It is handy to have a spare body near the hive so that the frames, as they are examined, may be placed therein; otherwise while one comb is being examined the queen may pass from an unexamined comb to one that has been examined and replaced, and thus she will be missed. If all combs have been examined and the queen not found, carefully examine the floor board and sides of the hive, then re-examine the combs as they are replaced. If she cannot be found another method may be adopted.

Remove the hive some 10 yards away in front of, and with the entrance facing, the old bee stand. Place an empty hive on old position. Now place a white sheet or piece of newspaper in front of the old hive and an entrance guard over the entrance, open the hive, take out two or three combs of brood and examine for queen. If not found, shake most of the bees on to the sheet, examine again, and if no queen, place these combs in new hive and fill up the space with empty combs on sheets of foundation. All flying bees will now return to the new queenless hive. Examine bees on sheet, and if queen is not found, take several of the remaining combs and shake bees off on to the sheet, examining bees after each shaking for the queen, then replace combs in old hive. If queen has not been found, close up the hive and leave until next day. In the meantime large numbers of bees will have sought their old stand and entered the new hive. As the number of bees in the old hive will now have been much reduced, it should not now be difficult to find the queen. This having been done, all the old combs and bees may be transferred to the new hive; or the old hive can be replaced on its old stand and the combs and bees in new hives transferred to it.

The queen having been disposed of, the usual method is to leave the hive queenless for a day, then taking the mailing cage in which the queen has been received, remove the cork or corks and also remove one frame from the hive and wedge the cage in the centre between the remaining frames. In the course of a few days the bees in the cage and those outside will have eaten away the candy and the queen bee released. By this time she will have the scent of the hive, and will be accepted.

Other methods of introduction are—

1. Smearing the queen with honey and placing her directly between the frames.
2. Wetting the queen with water and placing directly between the frames.

Both these methods depend upon the instinct of the bees to clean up the honey or water; by the time this is completed the queen and bees will have the same scent, and the queen will be accepted. Mr. Bartly, of Tasmania, claims that he has been successful with the water method in 98 per cent. of the introductions. His method is to wet the queen by placing her in a short glass tube partly filled with tepid water, shake the tube to and fro, pour off the water and allow the queen to walk down amongst the bees after giving a puff of smoke.

Yet another method which I had recommended to me, and which I have used with complete success, is the paper bag method. Take a small thin paper bag, such as is used for lollies, place the queen to be introduced therein, without any of her attendant bees, then catch half a dozen bees from the hive and place them in the bag with her. These bees should, if possible, be young and filling themselves with honey from the cells when caught. Although the queen is strange to them, they will be so busy trying to get out that they will not take any notice of her, and in the meantime they will all get the same scent. Remove one frame and place the bag in the hive between the frames, and in the course of a few hours the queen will have been released and accepted. The advantage of this method is that there is no need to leave the hive queenless for a day. I have opened a hive, destroyed the queen, and introduced a new one in a paper bag straight away with considerable success.

Whatever method is adopted, the hive should not be disturbed for about three days, after which time it should be opened to see that the queen is "O.K."

Pollen.

As has already been mentioned, apart from honey, the future generation of the hive depends upon a supply of pollen. Pollen is the reproductive substance of flowers, which is transferred from the male to the female portion of the flower or from the male flower to the female flower for the reproduction of species. Nature has provided various methods for this transfer. Amongst these are flying insects, of which bees are the principal. Pollen is the vital substance of the flower in concentrated form, is highly nitrogenous, and contains necessary vitamins. Nature is always prolific, and provides more than is necessary for reproduction purposes. Bees as they visit flower after flower carry the pollen from the anthers and fertilise the styles. In doing this they take a toll for their service, and carry some of the surplus pollen away to their hives to make food for their young larvae. When breeding is taking place the nurse bees consume honey and pollen and convert this into chyle food, which is deposited in the larvae cells.

If there is a shortage of pollen, therefore, breeding suffers, and the colonies do not build up, or may dwindle if insufficient bees are not bred to make up for wastage. The importance, therefore, of a pollen substitute has been realised by beekeepers for many years. From experiments that have been made it is evident that the question must be studied scientifically. Recently the Beekeepers' Association of Victoria approached the Commonwealth Committee of Scientific Research with a request that investigation should be made to find a pollen substitute, and this investigation has now been commenced.

The question is being studied in other places, and the following particulars of experiments at the College of Agriculture and Forestry, Brno, Czechoslovakia, will be of interest to beekeepers. As far back as 1871 Fischer propounded the theory that the pharyngeal gland was the source of the larval food. Stephen Soudek at the above College has recently been making microscopical studies of this gland, and his experiments therewith confirm Fischer's conception.

He fed very young bees, which had just emerged from the cells, with different foods and compared their action on the pharyngeal gland. He found that these glands only developed with those bees whose food had contained pollen. In cases where the food only contained honey or sugar, these glands shrunk up, proving the real importance of pollen. After this he tried many substitutes, amongst which were wheat flour, wheat bran, starch, ground beans, olive seed cake, linseed cake, peanut cake, ground fish, ground meat, etc. All of these did not bring the pharyngeal gland to development. Only in two cases did the glands become fully turgescent. These were when the young bees were fed with fresh egg albumen stirred into sugar syrup or with dried yeast. He, therefore, assumes that these substances can replace pollen, but states that many further experiments will have to be made before any pronouncement can be made.

He, however, advises beekeepers that as we know of no definite pollen substitute they should, when there is a lack of pollen, feed the bees with the fresh white of an egg stirred into sugar syrup. Pine pollen collected the previous season did not provoke any development of the gland. Bees fed on the yoke of an egg, ground meat and ground fish died in a few days. It is surprising the variety of substances bees will carry into their hive when there is a shortage of pollen. They realise the need for some such substance, and in their extremity have been known to work on wheat shorts fed to cows, fine sawdust, and even coal dust.

Old pollen that has been stored in the comb for a long time seems to lose its goodness, and bees always prefer the fresh gathered substance.

If there is old hard pollen in the hive, and yet no breeding taking place at the usual time, I would recommend the removal of this pollen by scraping down the

comb with a sharp tool almost to the midrib, then pound the pollen—if particles of comb are mixed with it, it will not matter—and stir in with the fresh white of an egg mixed with sugar syrup.

If any method of feeding pollen, or pollen substitute is adopted, care must be taken to feed slowly and to keep up the supply until natural pollen comes in.

Ants and Stands.

In some districts ants are a great pest, not only attacking bees that alight on the ground, but climbing the hive and entering therein; the small sugar ants frequently making their nests between the quilt (where these are used) and the cover. That is one reason why I do not recommend the use of quilts. It is far better to have a bee space of ¼in. between the tops of frames and the cover.

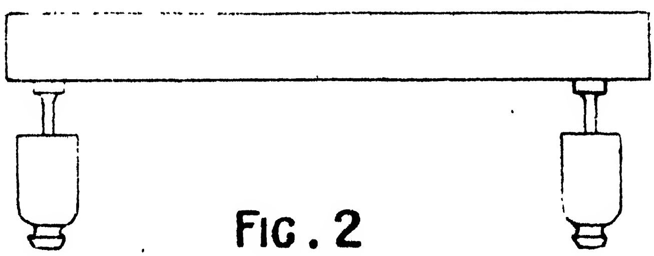


FIG. 2

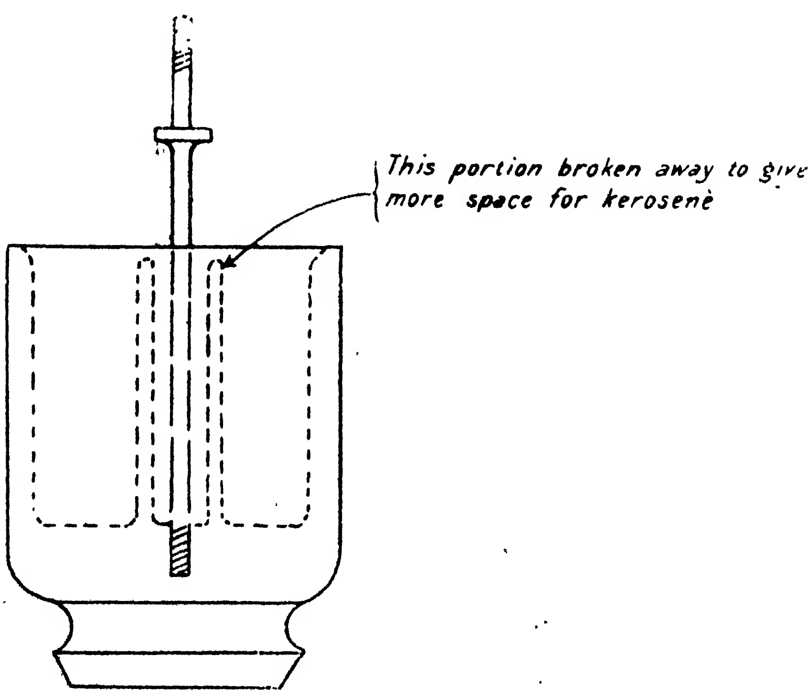


FIG. 3

The larger types of ants, particularly the Meat Ant (*Iridomyrmex detectus*) attack the hives and cause large numbers of bees to stay home to defend the entrance.

If nests can be located, bi-sulphide of carbon, sheep dip, or cyanogas are good substances for destroying same. A hole, several inches deep, according to size of nest should be made in the centre, and a quantity of one of the above substances put therein, and the hole covered up. If the nests cannot be located or are too numerous, a good ant-proof stand may be made from old telegraph insulators, as shown in Figure 2. Four pieces of 3 x 2 inches may be nailed together to make an oblong the size of hive, and four inverted insulators let in to the corners. These should be of the hollow type, and the inside collar of china broken away (see Figure 3). This space will now form a cup, which is filled with kerosene or old motor oil from the sump.

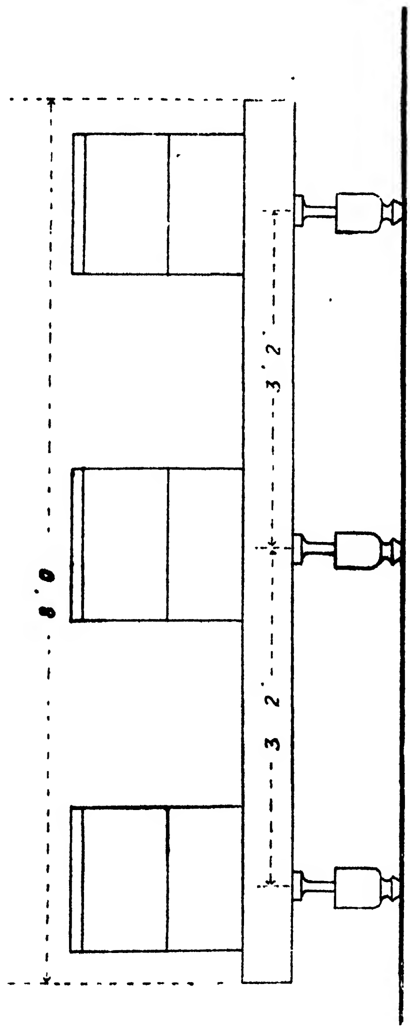


FIG. 4

If there are a large number of hives, stands to carry three hives are very convenient, and only six insulators need be used instead of 12. If the stand is made nine feet long, this will allow spaces between the hives for placing supers, etc., when manipulating. The insulator legs should be placed directly under the hives, and as these are frequently screwed on to the metal shanks, they can be screwed up or down to adjust the stand to a level. (See Figure 4.)

If old insulators are not obtainable the legs of the stand may be made of jarrah, and stood in the bottoms of petrol tins cut down to about 3 inches deep, and filled with oil.

Moths and Foul-Brood.

The Greater and Lesser Wax Moths are often blamed for more than their share of destruction in beehives. Owners of bees often say that moths are responsible for the loss of their bees, but in most cases it is due to inexperience or careless beekeeping. Even beekeepers of long standing make this mistake.

In the first place, colonies must be kept strong with bees of a good pedigree. By this is not meant one body-box full of bees and one or two half-empty supers on top. There must be plenty of bees on all combs in districts troubled with moth. As regards pedigree, most Italian strains are good battlers against the moth pest, some better than others. Secondly, a large number of home-made hives have not the correct spacing. In many cases the frames are too close to the bottom or sides of the hive. In others they are too close to the cover. In other words, there is not what is called a bee space on all sides of the frame. The bees cannot get through, and start filling the space with propolis. But the moth grub can and does get into these spaces, and the bees, however eager they may be, cannot get at the grub.

In some cases beekeepers use mats of roofing felt, sacking, or other material over the top of the frames; the bees cannot get between the mat and the frame, but the grub can and does. These mats are also a harbour and nesting place for ants. In one case, out of 16 hives with mats on, 15 had ants' nests with thousands of eggs between the mat and the cover.

In normal cases strong colonies should have an entrance of ⅜in. deep by the full length of the hive, but if the colony becomes weak the entrance should be contracted by placing a strip of wood along the entrance, reducing this according to strength from the full entrance down to two inches. This will assist the bees to guard the entrance against the moths and robber bees.

If, however, the colony becomes very weak it should be united to another colony. Two weak ones united stand a chance of building up to one strong colony, but if left alone will probably succumb to moths or robber bees.

Do not leave hives more than twelve months without cleaning the floor boards; excessive accumulation of cappings or refuse is a harbour for moth grubs. Once a year at least the floor boards and interior of the hives should be scraped and scrubbed with a solution of Izal; one part of Izal to 300 parts of water will be strong enough. Then leave to dry in the sun.

Always remember that prevention is better than cure.

Dealing with the connection of Moths with Foul Brood, some people think that there is no connection between the two, but in more cases than one I have found that moths have been blamed for destruction which has really been due to Foul Brood. The moths had only come in afterwards. In the meantime robber bees came along and cleaned up the honey, and carried the infection to other hives.

In one recent case the owner found a hive empty, except for moths. He told me that he had fumigated this with bisulphide of carbon, and put a swarm into it. On examination nearly all the combs were found to have either infected larvae or dried-up spores of Foul Brood. On examination of other hives they were found to have Foul Brood in the early stages. Probably all of these had started from the one empty hive.

Moral—do not blame the moths for all empty hives. The colony may have got weak through a failing or poor queen. The hive may have been so constructed as to assist the moth and hinder the bees, or Foul Brood may have been the cause of the loss of the bees.

The last cause is a very insidious and dangerous one, as it may cause the spread of this very infectious disease due to mistaken diagnosis.

As Foul Brood has been found in various parts of the State, it behoves all beekeepers to endeavour to correctly ascertain the cause of weak or empty hives. Any empty hives, with or without moth, should be carefully examined for the spores of Foul Brood in the brood combs, and if any doubt exists, a sample piece of the comb should be sent to the Department of Agriculture.

Leaflet No. 152 on "Bee Diseases" is issued free by the Department of Agriculture, and can be had upon application.

SEED SCARIFYING EXPERIMENTS WITH LOCALLY GROWN LEGUMES.

T. C. DUNNE, Merchants' Research Officer in Agrostology, Muresk Agricultural College,

and

H. G. ELLIOTT, Agricultural Adviser, Department of Agriculture.

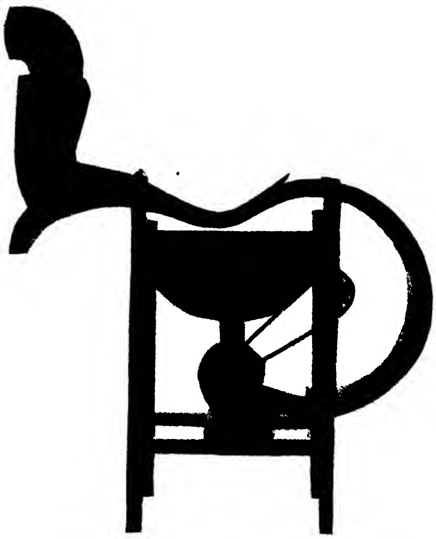
Legume seeds generally are characterised by a percentage of hard seeds, which may vary considerably from district to district and from season to season. The following table shows the figures for germination and hard seed content of a number of samples tested at the Department of Agriculture during the past nine years:

TABLE 1.

Seed.	Germination.		Hard Seeds.	
	Average.	Range.	Average.	Range.
	%	%	%	%
Subterranean Clover	66·4	41·0—99·0	28·3	0·0—57·5
Lupins	19·9	6·0—45·0	58·0	28·0—86·0
Drooping Flowered Clover	20·0	0·25—40·0	71·7	57·0—99·0

It will be seen from the above figures for germination that, taking the average as a basis for calculation, the stand in the first year obtained from Subterranean Clover may be only $\frac{3}{4}$, Lupins $\frac{1}{5}$, and Drooping Flowered Clover as low as $\frac{1}{80}$ of that expected. The situation is due to the high percentage—in some samples—of hard seeds which may take from up to seven years or even longer to germinate. The reason for this lies in a surface coating, formed often in response to desiccation, which is impervious to moisture and thus prevents germination until such time as this becomes permeable. Under natural conditions weathering agencies will eventually damage portion of this coating with subsequent growth. Artificially the entrance of moisture can be accomplished by mechanical injury of the surface. Scratching of the seed has been found to be the most practical method of achieving this purpose. Most machines for such work depend upon forcing the seed against a rough inclined surface.

A new Ames Hulling and Scarifying Machine imported from U.S.A. by the Department of Agriculture depends on this principle, using garnet paper for scarifying. An illustration is shown below:—



The New Ames Hulling and Scarifying Machine.

In view of the high percentage of hard seeds encountered in most Clover samples this year, atention was drawn to the necessity for seed treatment, and experiments were accordingly conducted with this machine at the State Implement Works, Fremantle.

Lupins.—Experiments with Lupins showed that the construction of this machine is unsuitable. Feeding is through the fan, causing considerable breakage with such large seeds. The results obtained indicate that successful treatment could be obtained with small modifications of construction.

Subterranean Clover.—Results with this Clover indicate that samples which contain a high percentage of hard seeds may be treated to advantage.

Drooping Flowered Clover.—In view of the extremely low germination of this Clover and of its increasing popularity throughout the South-West portion of this State, most attention was given to its treatment. Furthermore, the machine is more adapted to scarifying seeds of this size.

Table 2 gives the results obtained with a small sample of seed procured from the Department of Agriculture:—

TABLE 2.

Treatment.	Germination.	
	Original Sample.	Scarified.
	%	%
Fan 2650 r.p.m.	0·25	40·5
Fan 2870 r.p.m.	0·25	46·75

In Table 3 are given the figures for a parcel of 1,000 lbs. treated for the Group Settlement Department. In this case the machine was working at full capacity:—

TABLE 3.

Treatment.	Germination. Original Sample.	Germination. Scarified.
	%	%
Fan 2870 r.p.m.	4·0	31·0
Fan 2870 r.p.m. Scarified twice	4·0	35·0

It will be seen from Table 2 that the faster fan speed resulted in better germination. On account of the construction of the machine, it was inadvisable to make a further increase in speed. In both cases a very large increase in germination was obtained. It will be noted that scarified seed may give over 180 times the germination of that untreated, and it is evident that a reasonably satisfactory germination of at least 30 per cent. may be expected from seed so treated.

In the trials conducted it was found that the capacity of this machine is in the vicinity of 2,000 lbs. of seed per day. The whole work can be satisfactorily handled by one man.

Any farmer desiring to establish a good stand in the first year may reduce the rate of seeding of Drooping Flowered Clover by at least 1 lb. per acre by using scarified seed. This represents a direct saving of about 10s. per acre, while the cost of treatment has been estimated to be in the vicinity of 1s. per 100 lbs. of seed.

Acknowledgment is made to M. G. Meadly, of the Department of Agriculture, who conducted the germination tests recorded in this paper.

MINERALS IN ANIMAL NUTRITION.

J. F. Filmer, B.V.Sc., Senior Veterinary Surgeon.

Food is the raw material from which all animal products are fashioned. Such a statement may perhaps appear trite, but the writer is of the opinion that it is not sufficiently realised that it is also true Nature, in its usual efficient manner, provided adequate food for the animals which were evolved without the aid of man. It remains for man to copy her example and provide in like manner for the animals which he has evolved from their natural ancestors. The ancestor of our 200-egg hen laid one clutch of eggs a year, and the only standard laid down for them was their ability to produce healthy chickens. The wild sheep grew only enough wool to keep itself warm, whilst our Merino is expected to annually produce enough wool to clothe a large percentage of the world's population. The race horse is expected to carry a man at a faster pace than its ancestors could gallop unburdened. The draught horse is expected to draw a load which often exceeds its own weight. The baby beef Shorthorn is required to produce 600 lbs. of beef at 18 months of age—a weight to which some of its ancestors never attained.

In nature the cow produced enough milk to rear its calf; an ordinary 600-gallon cow now produces enough milk each year to rear four calves, and a 2,000-gallon cow produces enough to rear 13 calves, while the annual yield of butter fat often exceeds the weight of the cow.

If the truth of the opening statement be realised, it will readily be conceded that the food which met all the requirements of wild animals will not suffice for the domesticated stock of to-day. The more an animal produces, whether it be eggs or energy, wool, beef or butter the greater will be the demand which it makes upon its food. Nor can these demands be satisfied by merely increasing the quantity of food, for in evolving high-producing animals man has frequently neglected to provide a capacity for an increased bulk of food. The problem which faces the animal feeder is to compress into a given bulk the whole of the constituents which are necessary not only for the growth and well being of the animal but for the formation of the animal's products which are to provide his income.

The animal body is comprised of the following constituents in approximately the proportions given:—

Oxygen	65
Carbon	18
Hydrogen	10
Nitrogen	3
Minerals	4
Total	100

Strange as it may seem the constituents which are most frequently deficient in food are those which appear in the smallest proportion in the animal body, namely, nitrogen and minerals. The number of minerals which are necessary for animal life is not definitely known, but it probably exceeds 20. Most of these are required in only very small quantities. But an absence or deficiency of any one of them may limit growth or production, may impair health, or may even cause death. If an animal's ration is deficient in any mineral, or in any other constituent, three alternatives are possible:—

1. It may eat more food and so, if its capacity is adequate, obtain sufficient of the deficient mineral.
2. It may decrease its production to the level provided for by the amount of the deficient mineral.
3. It may rob its system to provide sufficient of the deficient mineral to continue production at a level above that provided for in the ration. This process naturally cannot be continued indefinitely, and if persisted in causes impaired health and eventually death.

It is interesting to notice that neither horses, cattle, sheep or pigs were indigenous to Australia. This does not necessarily mean that Australia is not suited for the production of these animals, but it does indicate that whenever any new district is developed it may be found deficient in one or more of the minerals necessary for the profitable keeping of these animals.

The necessity for minerals depends upon three factors:—

1. Body building.
2. Body processes.
3. **Production.**

All animals require minerals for body processes such as digestion, the transport of oxygen and carbonic acid gas in the blood, nervous control, etc. If minerals are not present in sufficient quantity for these functions death takes place. The amount of mineral required for this purpose is small and relatively constant. It will, however, be readily seen that the amount of minerals required for body building and production must vary enormously. The quantity of minerals required by a young animal has been found to depend very largely upon its rate of growth. This will be illustrated by the mineral composition of the milk of different species, as may be seen from the following table:—

Species.	Time in which birth-weight is doubled.	Figures represent lbs. per 100 gallons of Milk.		
		Total Minerals.	Lime.	Phosphoric Acid, P_2O_5.
	days.	lbs.	lbs.	lbs.
Man ...	180	2·5	·49	·56
Horse	60	3 8	1 14	1 21
Cow ...	47	7 2	1·61	1·89
Sheep	15	8 9	2·77	2·60
Pig ...	14	10·3	3·95	3·33
Dog ...	9	10 1	3·38	3·64
Rabbit	6	25·0	.	...

It follows, then, that as we evolve more rapidly-growing cattle, sheep, pigs and poultry so must the percentage of the minerals in their rations be increased.

When production is considered we are again thrown back upon the opening sentence. Whatever the animal produces must be manufactured from its food. This is just as true of minerals as of any other food constituent. A hen laying 200 eggs uses 2¾ lbs. of carbonate of lime in making the shells. A 2-gallon cow in 10 months puts into her milk nearly 10 lbs. of lime and over 11 lbs. of phosphoric acid. This is equivalent to the phosphorus content of 50 lbs. of bone meal. It might be thought that if a dry cow is getting sufficient minerals, that when she calves it would be necessary to add to her ration only the quantity of minerals which are contained in the milk she produces. Unfortunately this is not the case. For reasons which are not altogether clear, an animal is not able to utilise the whole of the minerals which it takes in its food. The percentage which it is able to pass on in its milk varies greatly with the form in which the minerals are given. It has been estimated that an animal is seldom able to utilise more than one-third of the lime or phosphoric acid in its food for milk production. It is therefore obvious that great care must be given to ensure an adequate mineral content in the rations of all high-producing animals.

Although, as has been pointed out, some twenty minerals are found in the animal body, it is generally sufficient to consider only seven of these, viz.: Sodium, Chlorine, Calcium, Phosphorus, Iron, Sulphur, and Iodine. In the great majority of cases there is an adequate supply of the other animals, though it is extremely likely that some of the obscure diseases of animals may prove to be due to a deficiency of one or more of these rarer elements.

A short discussion of some of the functions of the above seven minerals may perhaps serve to emphasise their great importance in animal nutrition.

Sodium.—This mineral has a host of functions to perform. It takes part in a complicated "buffer" system in the blood. This ensures that the balance between acids and alkalies is constantly maintained. The upsetting of this balance in either direction causes disease. Sodium is also largely responsible for maintaining the correct saline concentration of the blood and other body fluids. It is mainly responsible for carrying the carbon dioxide from the tissues to the lungs, where it is given off in the breath.

Clorine.—This is utilised in the formation of hydrochloric acid which is essential for the digestion of food in the stomach. It also assists in preserving the acid-alkali balance, and in combination with sodium assists in preserving the correct saline concentration of the body fluids.

Sodium and chlorine combine to form sodium chloride or common salt, and they are generally given in this form. Deficiency of salt causes indigestion, depraved appetite, and general unthriftiness.

Iron.—Iron enters into the formation of haemag'obin, which is the red colouring matter of blood. Its function is to carry oxygen from the lungs to the tissues. It apparently has other rather obscure but very important functions to perform in the body.

Deficiency of iron causes anaemia. It is interesting to note, in passing, that recent work in America has demonstrated the fact that small traces of copper are necessary, in association with iron, for the cure of anaemia.

Iodine.—This is needed in only very small quantities, but these traces are absolutely essential. It enters into the structure of the thyroid gland which has many important functions in connection with the controlling of growth and the proper utilisation of protein, calcium, and phosphorus. Deficiency causes goitre, sterility, hairlessness, and other more obscure diseases.

Sulphur.—Sulphur is an important constituent of wool. It has generally been thought that this mineral is only of value in food when given in complicated organic compounds. Recent work in South Africa has suggested that it may be of value to sheep in its more familiar form. Confirmation of this work should prove of great interest to Australian sheep owners.

Calcium.—This is the mineral which, in combination with oxygen, forms lime. It enters into the formation of bones and is an important constituent in milk. It is the main constituent of egg-shells. It has an important function in the control of nerves. Deficiency causes bone diseases, nervous symptoms, sterility, general unthriftiness, and lowered production. The rapid withdrawal of calcium from the blood has now been shown to be the cause of milk fever.

Phosphorus.—This enters into the formation of most tissues. It is one of the main constituents of bone. It is found in all cell nuceli. It is an essential ingredient of milk. It assists in the preservation of the acid-alkali balance in the blood. Deficiency causes bone diseases, unthriftiness, sterility, lowered milk production, and depraved appetite. This latter symptom, generally seen as bone chewing, results in the animal ingesting the toxin which causes toxic paralysis or botulism, which has caused such serious losses in cattle and sheep during recent years.

Sufficient has perhaps been said to emphasise the necessity for an adequate supply of minerals in the ration. We may therefore turn to the consideration of the problem of how best to supply the requisite minerals. Three principles may be laid down in regard to the sources of minerals.

1. The minerals must be present in such a form as to be available for use by the animal.

2. The materials used must be palatable, or at least they must not be unpalatable.

3. They must be sufficiently cheap to be capable of being fed economically.

In regard to grazing animals the main source of minerals, as of all other food materials, must always be pasture. Fortunately green pasture, which is properly managed, will in the great majority of cases provide all the mineral requirements of our horses, cattle and sheep, but it must be properly managed. In good pasture management, four things need careful attention.

1. Proper choice of pasture plants.
2. Proper manuring of pastures.
3. Proper grazing of pastures.
4. Proper conservation of pastures.

Choice of pasture plants and manuring of pastures lie somewhat outside the scope of this paper, but they are obviously of the greatest importance in ensuring an adequate mineral content in the food of the grazing animal.

The importance of proper grazing is not sufficiently realised. In order to obtain the best results from a nutritional view-point from pasture, it should be short, green, leafy and vigorous

Subdivisional fencing and frequent rotation of stock from paddock to paddock materially assist towards obtaining these desired attributes.

A few figures will illustrate the importance of this.

SUBTERRANEAN CLOVER.

Date.	Length of Stem.	Phosphoric Acid (P_2O_5) in 100 lb. of dry matter.
July	3 inches	·67 lb.
October	8 inches	·64 lb.
November	9–24 inches (in flower) . .	·34 lb.
Hay	... .	·27 lb.

GREEN OATS.

Date.	Height.	Total Minerals in 100lb. dry Matter.	Phosphoric Acid (P_2O_5) in 100 lb. dry Matter.
July	6–8 inches ...	7·84 lb.	·85 lb.
October	18 inches ...	5·97 lb.	·34 lb.
November	3ft. 6in. (in ear)	2·77 lb.	·16 lb.

The clover in July and October and the oats in July contained adequate supplies of minerals, but the rank growth of later months was very deficient in phosphoric acid.

Proper conservation of fodders should go hand in hand with proper grazing and proper manuring. In the flush period in our South-Western districts the stock are often quite unable to cope with the pasture. The conservation of silage then serves a double purpose. It not only provides a reserve of succulent fodder, but the use of the mower assists in keeping the pasture in the desirable short, leafy condition. The proper conservation of hay is also of the greatest importance. Good hay should be made from pasture which has grown rapidly. In the South-West in good seasons six to eight weeks is often sufficient It should be cut while it is still green and leafy. It should not be exposed for long to the direct action of the sun's rays.

Numerous experiments have shown that hay prepared in this way not only contains more minerals, but that they are pound for pound of greater value to the animal. The same principles apply with equal force to the conservation of cereal hays. There is very real justification for the popular preference for chaff of a good green colour.

The whole question of pasture management is of the most vital importance, and results are already proving the value of the research work which has been, and is being carried out. At the Rowett Institute in Scotland it has been shown that properly managed green pasture will supply the whole of the requirements of a 12 cwt. cow giving four gallons of milk daily. Such a pasture is undoubtedly the best solution of all the nutritional problems that confront our dairymen, and where the rainfall is adequate, it should be their constant objective.

However, during the dry summer months, it is not possible to provide sufficient green grazing to supply the mineral requirements of our stock. It is then necessary to use supplements and the mineral constitution of some of these will be briefly considered.

All grains are fairly rich in phosphorus, but are relatively poor in other minerals. One pound of oats contains about as much phosphorus as half an ounce of bone meal.

Peas, beans and linseed are rather richer in minerals than cereal grains.

Bran is very rich in phosphorus. One pound of bran contains as much phosphorus as two ounces of bonemeal. This, in part, accounts for its great value as a fodder for dairy cows. Hay made from lucerne, clover, peas, vetches or other legumes is rich in lime.

Milk is rich in almost all minerals with the exception of iron. One gallon of skim milk contains as much phosphorus as 1½oz. of bonemeal.

Fish meal is rich in minerals and in other countries is widely used. Its economical production would be of great value to Australian stock owners.

Bonemeal is rich in both phospohorus and lime, and where it can be economically procured, is one of the best sources for these minerals.

Dicalcic phosphate is probably the most practical available source of phosphorus in Western Australia to-day. The pure chemical contains about 40 per cent. of phosphoric acid. A lick containing 18 per cent. of phosphoric acid in the form of dicalcic phosphate is now available at about half the cost of bone meal. South African experiments have shown that such a lick is probably twice as valuable as bonemeal as a source of phosphorus.

In preparing mineral supplements for farm animals, it is necessary to consider three things:—

1. The minerals which are required by the animals in question.
2. The mineral content of the foodstuffs being used.
3. This is really a subdivision of (2). Any mineral deficiency which exists in the pasture of the districts or during the season concerned.

Horses do not grow very rapidly and are not expected to produce large quantities of milk. Consequently their mineral requirements are small. Usually the provision of rock salt is all that is required.

Pigs grow extremely rapidly, and it is perhaps not generally known that a sow gives about one gallon of milk per day. Pigs are largely fed on grain which

is notoriously deficient in minerals with the exception of phosphorus. A sow, giving a gallon of milk and being fed entirely on wheat, would need to eat at least 125 lbs. a day in order to get sufficient lime. A young pig gaining 1 lb. per day would require to eat 50 lbs. of wheat per day to get sufficient lime. The phosphorus requirements of the sow could be obtained from 8 lbs. of wheat and that of the young pig from 3 lbs. of wheat.

It is apparent that pigs on grain rations are likely to suffer from lime deficiency, but with the possible exception of breeding sows, are not likely to be troubled by phosphorus deficiency. Grains are also known to be deficient in salt, in iron, and occasionally in iodine, and these minerals must be considered in compounding the pigs' ration. Milk is a splendid source of minerals for pigs. One gallon of skim milk contains as much lime as 7 lbs. of wheat. Fish meal is an excellent source of minerals and protein, and is much used in other countries at the rate of 10 per cent. of the meals fed. One pound of fish meal contains as much lime as 167 lbs. of wheat. Meat and bone meal is an excellent source of minerals and protein, but meat meal should be considered as a protein supplement only. Where fish meal and milk are not used, the following mineral supplement has given excellent results in Scotland:—

Salt	4 lbs.
Ground limestone	8 lbs.
Bonemeal	8 lbs.
Iron oxide	1 lb.
Potassium iodide	1/8 oz.

Sometimes 1 lb. of sulphur is added.

The mixture is fed at the rate of 2 to 4 lbs. to every 100 lbs. of grain. The higher rate is fed to breeding sows. On account of the high cost of bonemeal in Western Australia and the doubtful necessity for a phosphorus supplement, one is inclined to suggest its omission. The idea that a phosphorus supplement is needed by grain-fed pigs dies hard. Those who still cling to this belief could re- their souls and ease their pockets by substituting 4 lbs. dicalcic concentrate (30 per cent. P_2O_5) for 8 lbs. bonemeal, but with a possible exception in the case of brood sows, this is not considered necessary.

In America, where young pigs often become anaemic, the trouble is prevented by allowing them to root in blue grass plots. Kikuyu grass would probably prove ideal for this purpose.

The effect of feeding minerals is admirably shown in the following two experiments.

EXPERIMENT WITH SEVEN SOWS.

—	Average number of Pigs per litter.	Average number alive at five weeks.	Average number of Pigs at weaning.
Before feeding minerals	7	3·7	2·4
After feeding minerals—First litter ...	10·4	7·1	7·1
After feeding minerals—Second litter	9·7	8·1	8·1

A mineral supplement similar to that given above was fed at the rate of 4 lbs. per 100 lbs. of grain.

An experiment with three lots each of 20 young pigs. The ration consisted of grain and each lot had a run of 2 acres.

Average Increase of Weight per Pig per Day.

—	28 days.	19 days.	20 days.	20 days.	15 days.	Whole time 102 days.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
No minerals	1·12	1·05	1·08	·95	1·34	1·09
2 per cent. minerals ...	·97	1·10	1·36	1·43	1·89	1·32
10 per cent. fish meal	1·04	1·06	1·52	1·43	1·55	1·32
Remarks	skim milk fed	No skim milk fed.				

It will be noted that where skim milk was fed, no benefit appeared to result from the addition of minerals, but immediately it was withdrawn, their benefit became readily apparent. The total average growth over the 74 days when skim milk was not fed was:—

No minerals	81 lbs.
2 per cent. mineral	105 lbs.
10 per cent. fish meal	102 lbs.

Both these experiments were conducted by R. G. Basket in Ireland.

Poultry are grain eaters and egg producers. They are, therefore, receiving a lime deficient ration and at the same time giving off relatively large quantities of lime in the form of egg shells. Lime is, therefore, probably the mineral which requires to be given in largest quantities. In other countries this is generally provided in the form of fish meal or bonemeal. The following have been used successfully:—

Fish meal—10 per cent. of the mash;

Bonemeal 4 parts; salt 1 part—given as 5 per cent. of the mash;

Bonemeal—100 parts;
Ground limestone—40 parts;
Salt—40 parts;
Sulphur—10 parts;
Iron oxide—10 parts;
Potassium iodide—1 part.

The mixture is given as 5 per cent. of the mash. As in pigs, one feels that the bonemeal might well be replaced by an equivalent amount of ground limestone.

Sheep and cattle on good winter grazing should not require mineral supplements. During our dry summer, however, they certainly require a phosphorus-containing supplement. The failure to provide a lick which ensures an adequate daily intake of phosphorus has this year been responsible for large mortalities amongst sheep and cattle, especially in the wheat belt areas. These losses have been due to botulism, a disease caused by germs which grow on animal debris. Bones, and particularly rabbit carcases, are very common sources of this trouble. During recent months, numbers of inquirers have stated that licks have been provided without the mortality ceasing. This is sometimes due to non-phosphatic licks being used. At other times the phosphorous content of the licks is low or the quantity of lick provided has not been sufficient.

Work at Understepoort, in South Africa, has shown that the optimum daily intake of phosphoric acid for two-tooth ewes weighing about 80 lbs. is about 1/8 ounce. For 100 sheep for a week this would be 5½ lbs. The amount of phosphoric acid which 100 sheep would obtain in one week from our summer pasture is about 3 lbs., and in parts of the wheat belt may be even less. This leaves a deficiency of 2½lbs. of phosphoric acid. This would be provided in 14 lbs. of dicalcic lick having an 18 per cent. phosphoric acid content. This should be taken as the minimum amount of lick to be provided in the wheat belt.

Oats are often fed to sheep in this State, and it is interesting to note the phosphoric acid content of this important feed. 1,000 lbs of oats contains 8 lbs. phosphoric acid. If oats are fed at the rate of 1 lb. per day per sheep they will supply in one week to 100 sheep about 5½ lbs. phosphoric acid. This, it will be noted, is exactly the amount which the South African authorities have found to give the best results.

Oats may be highly recommended as summer feed for sheep as they supply protein as well as phosphorus, and this ingredient is also sadly lacking in our summer pastures. They also serve as an excellent medium in which to administer licks and solve the whole problem of palatability in a convenient and economical manner. The licks should be thoroughly mixed with the oats. The following are the figures for 100 sheep for one week. They should be accepted as minimum figures for the wheat belt and may, if necessary, be increased:—

No oats 14 lbs. dicalcic lick.
175 lbs. oats—11 lbs. dicalcic lick.
350 lbs. oats—8 lbs. dicalcic lick.
525 lbs. oats—4 lbs. dicalcic lick.
700 lbs. oats—no lick required.

These figures are for light weight merino sheep, and should be increased for heavy crossbred or British breeds of sheep.

Feeding of licks should commence from the time the pasture seeds and should continue until green grazing again becomes available.

For cows the quantity of lick required depends largely on the amount of milk produced. Green in South Africa has shown that bone chewing commences when the phosphorus falls to a certain level, which is expressed as a ratio between the phosphorus content and the energy produced by the ration. In order to bring the phosphorus level in our summer pasture up to the point where bone chewing ceases, it would be necessary to give a dry cow 2ozs. dicalcic lick per day. But in order to bring the phosphorus level up to that of good English hay, it would be necessary to give over 5 ozs. of dicalcic lick per day. The question of supplying minerals to milking cows during the few months in which they are dry, is of the greatest importance. It has been shown that heavy milking cows on the best possible rations will often rob their system of minerals. Their only chance to replace these is during the short interval between the periods of lactation.

Stewart, of Cambridge, has calculated that a 4-gallon cow requires just over 3.1/3 ozs. of phosphoric acid per day. Other observers have stated that 1oz. of phosphoric acid is required for every gallon of milk produced. A cow feeding on our dry summer pasture would get only 1¼ ozs. of phosphoric acid per day. Thus, for a 4-gallon cow there would be a deficiency of from 2 to 2¾ ozs. phosphoric acid per day. 13ozs. of dicalcic lick contains 2.1/3ozs. phosphoric acid.

It may therefore be stated briefly that cows confined to dry summer pasture would require the following quantities of dicalcic lick:—

	ozs.
Dry cow	5
1-gallon cow	7
2-gallon cow	9
3-gallon cow	11

2ozs. for every extra gallon of milk produced.

It is, of course, customary to feed concentrates to cows during summer. If crushed oats are fed 1oz. of lick may be deducted from the total for every 2lbs. of oats fed. Bran is very rich in phosphorus and 2ozs. of lick can be replaced by 1lb. of bran. Two examples will show how the amount of dicalcic lick required may be calculated.

For a 2-gallon cow receiving 6lbs. crushed oats—

For cow	5 ozs.
For 2 gallons milk	4 ozs.
Total	9 ozs.
Deduction for oats	3 ozs.
Quantity of lick to be fed	6 ozs.

For a 3-gallon cow receiving 5lbs. of bran—

For cow	5 ozs
For 3 gallons milk	6 ozs.
Total	11 ozs.
Deduction for 5lbs. bran	10 ozs.
Quantity to be fed	1 oz.

On account of the salt content it is suggested that where it is necessary to use more than 4ozs. of dicalcic lick per day, that the dicalcic concentrate be used instead. 3ozs. of dicalcic concentrate is equivalent to 5ozs. dicalcic lick.

All these figures have been based on the assumption that the sheep and cows have been on rations containing sufficient phosphorus prior to commencing the feeding of lick. If animals have been on phosphorus deficient rations for any length of time, it may be necessary to greatly increase the quantities suggested.

Theiler, in South Africa, quoted cases of cows whose system was so depleted of phosphorus that it was necessary to give licks for two years befor the system recovered sufficiently for the cow to be got in calf.

The figures for oats and bran may, perhaps, have to be revised for these commodities where they are produced in phosphorus deficient districts.

The dicalcic lick referred to in this paper is compounded as follows:—

Commercial dicalcic phosphate	45
Salt	40
Molasses	5
Water	10

This contains 18 per cent. phosphoric acid (P_2O_5), of which 90 per cent. is present as dicalcic phosphate of lime. A dicalcic concentrate is available which contains 30 per cent. phosphoric acid. By mixing six parts of this with four parts of salt, the lick above given is obtained. Any lick containing 18 per cent. of phosphoric acid in the form of dicalcic phosphate may be used in the proportions quoted. Where the phosphoric acid is present as tricalcic phosphate, a larger quantity of lick would need to be used unless the lick contained more than 18 per cent. of phosphoric acid.

In conclusion, one would urge all stock owners to include in their creed the following eight principles:—

1. All stock require minerals.
2. Young rapidly growing stock require fodder that is particularly rich in minerals.
3. Minerals must be given to supply those given out in milk or eggs.
4. Young short leafy pasture is rich in minerals.
5. Summer pasture in Western Australia is almost invariably deficient in phosphorus.
6. Minerals in pasture may be increased by proper top dressing.
7. Silage and properly cured hay are richer in minerals than old dry pasture or hay that has been made too late or that has been too much exposed to the sun.
8. Minerals supplements should be prepared in a rational way to contain the minerals that are deficient in the feed and should be fed in the correct quantities.

SOME METHODS OF GRAFTING.

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To the ancients the phenomenon of grafting and budding was a very misunderstood subject. Many wild claims were made even by prominent men. Virgil speaks of a plum tree that bore apples after having been grafted. Martial advised the grafting of the cherry on the poplar. Columella in a like manner claims that the olive should be grafted on to the fig. Other extravagant claims included the following—that the orange grafted on the holly would ensure the former being acclimatised to the open woods, and that the vine grafted on to the walnut would enable the grapes to contain oil.

These wild claims, however, indicate that the art of grafting was recognised, and to some extent it must have been practised, but it is only recently that the absurdity and the idea that man was degrading Nature by such practices, have been mostly eliminated.

The scope of grafting is enormous—a fact not realised by many people. Together with budding, it is employed on nearly all our orchard trees, though to some extent walnuts, plums, and loquats are propagated by cuttings. Grape vines in the main viticultural countries also require to be grafted. One would naturally

assume that a tree on its own roots would flourish much better than when grafted on to another's. Perhaps it would, but there are other factors to be considered. The following are some of the more important:—

1. Grafting is used to perpetuate a variety of fruit. Let us take an example. The "Granny Smith" apple tree was noticed many years ago growing in New South Wales. Its qualities were outstanding. Since then many thousands of trees have been derived from it. The seeds very rarely come true to type, and in the early stages of propagation, cuttings would be a more wasteful way of perpetuation.

The navel orange furnishes another excellent example of the perpetuation of a variety. The navel orange is seedless, and this fact is important, for without the processes of grafting and budding, and the use of cuttings (which is a slow means of propagation), it would be impossible to perpetuate the variety.

Brazil is the home of this orange, where it arose as a "sport." It possessed so many obvious advantages over the other varieties of oranges, that for its commercial perpetuation a rapid and sure means of propagation was desired. The means, rapid, easy and reliable, was at hand—budding—a form of grafting in which only a single bud, with or without adhering wood, was used as the scion—the stock, the rough lemon or citron. Since then, in a comparatively few years the navel orange has spread over the world, and forms to-day one of the most common and popular varieties of orange.

Most of our varieties of fruit trees are budded or grafted they are kept true to name and variant factors are kept at a minimum. When these variant factors do arise, possessing exceptional qualities, then they, too, can be perpetuated. The varieties of navel oranges again form examples.

2. Grafting is employed also to mitigate the ravages of disease—particularly for such fruits as the apple, citrus, and the grape vine. Most apples are in Australia grafted on to "Northern Spy" stocks for the reason that this variety of apple is very resistant to the root attack of Woolly Aphis (*Shizoneura lanigera*).

European grape vines are grafted in most other countries of the world on to American varieties. The reason being to prevent the practical extinction of the varieties of the *Vitus vinifera* due to the ravages of the terrible disease known as Phylloxera, caused by a species of aphis known as *P. vastatrix*. This disease was introduced into France during last century on stocks imported from America to minimise the effects of the fungus disease known as Powdery Mildew (*Oidium*). The ultimate result was the complete annihilation of the European vines, except in some isolated areas. This meant that fresh plantings had to be made of grafted vines and cuttings—all on American stocks which are very resistant to the disease.

Vinegrowers in Western Australia are particularly fortunate, for this dread disease is not present.

3. Grafting may modify the stature of the plant. One may desire dwarf trees, and these may be obtained by using for apples the stock known as "Paradise," and for pears, quince stocks.

4. Grafting is also very useful, in many cases imperative, for the adaption of varieties of fruit trees to various soil types. It is common knowledge that the various kinds of fruit trees have individual tastes concerning location, soil, and climate, and grafting is used to modify these preferences. Plum stocks are used for peaches on heavy lands, and *vice versa*, peach stocks for plums on light lands. In some chalky districts in England almond stocks are used for apricots. These are a few examples only of stock modification of varietal preferences.

5. Grafting, including budding, is very useful in nurseries to accelerate the fruitfulness of new varieties of fruits under test. One would have to wait a considerable time for a seedling to fruit naturally, but by using grafts and buds we are able to secure results in a very short space of time.

Grafting, although not a new method, may be freshly adapted to meet varying conditions of soils, and to change over unprofitable varieties of fruit trees to those better suited to climatic and market requirements.

The terms used in grafting will be understood by most, but for those not so conversant a few explanations will be necessary.

A graft is composed of two components—one, the scion, the portion of the plant one desires to propagate, whether bud, spur, terminal shoot, or matured wood one season old, and the other the stock, or host plant. The stock, whether root, trunk, or limb, nourishes the scion if the union is congenial, permitting its growth and the retention of its varietal characters.

However, these varietal characters may be subject to modifications, as shown by recent research. Certain modifications one may remember, such as (a) dwarfness, (b) the adaptive nature of certain stocks for soil types, (c) increased vigor, and (d) many other modifications not usually noticed, but nevertheless playing very important parts.

Many fertiliser experiments on fruit trees have been failures, due almost entirely to the non-standardisation of stocks affecting the standardised scions, leading to results at once misleading and meaningless, even though carried out for thirty or forty years.

For most practical reasons, however, the propagation is true to type wherever the union of stock and scion is congenial. The scion is inserted into the stock by means which we will later explain, and commences to grow if the conditions are favourable. These can be enumerated—

(1) The contact between scion and stock must be perfect so that the cambiums are in close proximity. The cambium is that part of the plant that separates the xylem, wood, or water conducting and skeletal system of the tree from the phloem, or food conducting system. In young wood this cambium has the wonderful power of regeneration, furnishing wood cells on the inside and phloem on the outside. The cells occurring in the cambium are analagous to those found in the growing points of shoot or root. They are actively alive and are capable of fresh growth. It is now obvious that for a successful union these portions of our components must be in close contact so that by the rapid production of callous tissue the union is initiated before the scion is subject to the hot rays of the sun and desiccating winds.

(2) There must be a close affinity between stock and scion, *i.e.*, there must be close relationship botanically, though exceptions occur as they do in most rules. The flowering plants are divided into two sections—the Monocotyledenae and the Dicotyledenae: the former including the cereals and grasses, and the other our fruit trees. As one easily sees there is no affinity between a grass and a fruit tree. The Dicotyledenae is divided again into families, viz., the Rhamnales includes the grape vine and the Rosales includes the apple and pear trees. Therefore, the families are groups of plants possessing characters differing widely from each other, and are again lacking in affinity. The families are further divided into genera, each possessing allied features—for instance there are two genera in the Rhamnales, of which one is the Vitaceae, and seven in the Rosales. The genera then confined to a family are more closely connected, but still it is remarkably difficult for inter-grafting to take place except in rare instances. The genera are further divided

into species. In the genus Vitaceae we have, amongst others, the following species:—

(a) *Vitus vinifera*, the European grape vine as grown here;
(b) *V. labrusca*
(c) *V. riparia* } American vines.
(d) *V. rupestris*

Here there is a fairly close affinity, but not so close as one would expect. The American vines form stocks of varying utility, and the unions are often bad. Even amongst a genus the affinities of species for each other may still be poor. The change over to American stocks in other parts of the world entailed a tremendous amount of research work and many resultant failures and still the lives of the grafted vines are comparatively short.

The species are again divided into varieties. There are the Muscats, the Malagas, the Sultanas, the Red Princes, the Ohanez and thousands of others. Usually the affinities between these varieties are quite good and grafting is easily accomplished, but again we find that these varieties have individual tastes for soil, location and climate and much remains to be done to render desired varieties successful on stocks that in certain soils and locations on their own roots would be failures or else only partial successes.

For successful grafting a close affinity is necessary, and one finds it chiefly amongst varieties where, even there, it may still be a variable factor. The quince and loquat furnish an example of close affinity where the members of the union do not belong to the same genus.

(3) *Season.*—The usual time for grafting is in the spring at leaf-burst when the soil is moist and conditions ideal. The roots had commenced activity weeks before in preparation for the work ahead of them. The condition of the tree at this stage can be compared to a greyhound straining at the leash—all eagerness for the chase. The cambial tissues have the reserves of last year's growth and the early preparation of water and mineral requirements by the roots behind them, and they are eager and ready for the moment to commence growth. It is not surprising, then, that this is the ideal time for grafting, where the unions rapidly callous and growth commences, before the severe conditions of summer make themselves felt.

Other forms of grafting can be done at various times during active growth, viz., herbaceous grafting.

Budding can be done either in the spring or December-January for deciduous trees, or in the early autumn for citrus trees. The dormant buds give much better results.

(4) *Implements and Materials.*—The implement, of course, can do much to make or mar a successful graft, even when all the other factors have been favourable.

The grafting knife must be strong, finely bladed and possessing a keen edge. All cuts must be smooth and clean, thus ensuring a rapid callousing of the wounds. The mallet, or—as is sometimes used when much grafting is to be done—a wooden club, retained on the wrist by means of a leather band, must be strong and not too heavy.

The implement used for cleft grafting consists of—

(a) Handle.
(b) Blade—the extended portion forming a stout and sharp cutting edge.
(c) The distal extremity is curved upwards in the form of a wedge.

This tool is very convenient, the cutting edge, by the force of the mallet forms the cleft; when withdrawn and the wedge inserted, one is able to shape the stock, insert the grafts and when the wedge is withdrawn the scions are held firmly in position.

All implements, including saws, etc., must be kept clean and in good condition, for when one stops to consider one realises that a clean, healthy wound heals much more readily than does a dirty, ragged one.

The graft when made must be protected from the weather, otherwise drying winds would promptly end all chances of success. Therefore, all the winds must be amply protected and this is done by the use of grafting wax, waxed calico or muslin, or grafting clay.

A good grafting wax can be made from the following formula:—Resin, 2 lbs; beeswax, 1 lb.; tallow, 1 lb. This is applied by means of a brush—hot, but not too hot—over all the wounds.

The waxed cloth may be made by passing the strips of cloth from two rollers through the hot prepared wax and, by means of boards, stripping off the surplus. When dried it can be rolled and used when required.

The grafting clay is sometimes utilised, but it is more used when one is grafting vines A useful formula is as follows: Clay, 2 parts; rotted horse manure, 1 part; plus a little chopped hair.

(5.) *Treatment.*—The care meted out to the grafts is usually meagre. They reward careful attention by well directed growth, free from the competition of water shoots that often on vigorous stocks arise in profusion.

It is necessary—

(a) To bind the grafts, especially in windy locations, to stakes attached either to the limbs or fixed in the soil. Many losses occur every year that can be directly attributed to the force of the wind on unstaked grafts. The first callousing is, of course, composed of soft tissues that possess no strength of cohesion. Later the strength that very seldom becomes a weakness in the tree is developed.

(b) That the raffia or bindings used in tying the grafts must be removed before they become a menace in constricting the union as the graft comences vigorous growth. Many unions are ruined in this way.

(c) That water shoots and competing growths must be removed, otherwise the flow of sap is diverted to the stronger channels to the detriment of the graft. In some instances it is wise to retain such growths in order to subdue to some extent too vigorous scions, whose rate of growth is out of proportion to the rate of strength developed in the union.

This restraint on the scion can be applied also by judicious pinching out of the growing point. The rate of growth is checked and time is thus given for strength to develop in the union.

The care of the graft is amply repaid by strong well-directed growth capable of easy manipulation, and in the following season rewarding the operator by increased fruit production. Alas, too often is the graft left to struggle, unaided, by itself, and in the event of failure—only too common—the system, and not the operator, is to be roundly condemned, and, therefore, useless.

The preceding are, briefly, some of the factors affecting grafting. The subject is extremely large, and the scope of this article does not permit us to further enlarge on this particularly fascinating subject.

The following is a broad outline of the systems of grafting commonly used. We have done some considerable work on such methods of grafting that apply to the grape vine, the fig, the apple, citrus, and stone fruits.

Methods of Grafting.

I. Bud grafting or budding.
II. Grafting proper.
III. Bridge grafting and in-arching.

I. *Bud Grafting.*

(a) *Shield budding.*—The name "shield" is derived from the resemblance of the cut bud to the medieval shield. With deciduous trees, well-developed buds are cut from healthy shoots during the months of December, January, and February. By means of a T-shaped cut just reaching to the wood they are inserted into the stock and firmly bound with raffia or wool. This can only be successfully accomplished when the so-called bark comes easily away from the wood. The ligatures require to be removed 8 to 14 days after the operation, and the bud remains dormant until the following spring, when the stock above the bud is removed.

(b) *Flute budding.*—This method can be used for fig and walnut trees. The bud is obtained by two parallel and two perpendicular cuts into the bark: in the former case about half an inch below and above the bud, and in the latter about the same distance from the sides of the bud, which can then be easily detached. The shape is now fluted; hence the name.

The bud on the stock where the scion is to be received is cut similarly and removed. The exchange can now be accomplished, and the union is bound firmly with wool or raffia, care being taken not to cover or injure the bud proper. Flute budding is usually recommended in the spring for figs. Somewhat later in December it is used in other parts of the world for grape vines.

II. *Grafting proper.*

There are many systems in vogue but the following are in general use and most conditions in Western Australia. They will be discussed in detail later.

(a) *Whip and Tongue Grafting.*—This is, perhaps, the graft in most common use. It is particularly adapted for stocks of small diameters, and is extensively used by nurserymen for such trees as the apple and pear. It can also be applied by the orchardist to nearly all deciduous fruit-trees.

(b) *Strap Grafting.*—This form of grafting is an ingenious device for the grafting of stocks of large diameters, ensuring a quick and sure covering of the stump. Strap grafting is, perhaps, the most efficient system we possess, and can be applied to apple, pear, and stone fruit trees.

(c) *Cleft Grafting.*—Presenting such ease of operation, cleft grafting is used extensively in the field for such fruits as the apple and pear, stone fruits, figs, grape vines, mulberries, and citrus.

(d) *Bark Grafting.*—This method of grafting, with several modifications, is also commonly used for such fruits as the apple, pear, stone fruits, mulberries, figs, and citrus.

(e) *Inlaying.*—As will be seen later, inlaying presents features that appear to be admirably suited to the grafting of grape vines.

(f) *Herbaceous Grafting.*—The green shoots are used in this form of grafting. It is extensively used in European countries for grape vines, and is seen here practised by Slav workers in the Swan and Spearwood districts.

(g) *Bottle Grafting.*—The late Mr. Catton Grasby introduced this graft from abroad. Though tedious in maintenance, this system is an admirable and sure method of overhead working the grape vine.

III. *Inarching.*

Skin grafting and blood transfusions as practised by the surgeon have interesting corollaries in the realm of the horticulturist. The system of inarching seeks to transfuse new life into a tree weakened by root injuries, and the following method—

(b) *Bridge grafting* seeks to correct trunk wounds too large to deal with in Nature's way.

GRAFTING THE GRAPE VINE.

Grafting to many vignerons does not appear to be worth the trouble, nor to be worth while. We assure them that it is, and that returns are obtained much faster than from fresh plantings. Usually, it is most difficult to secure vigorous growth from initial plantings in situations where old vines have stood for years, unless the soil is removed and fresh good soil substituted.

The stock method of grafting is the cleft graft noted for the ease and comparative success of its operation.

It is performed in the Spring when the shoots on the stock are several inches in length and the sap pressure somewhat reduced. The scions are obtained from those stored during the winter months in moist sand. The stock is cut with the saw on a level, or a few inches above, the surface of the ground. The cleft grafting implement is placed diametrically across the stump and the force of the hammer or mallet ensures the splitting of the stump to a distance of three inches, when the implement is withdrawn and the wedge-like distal extremity is inserted into the cleft. While still in position, the cleft on each side is cut, starting from an inch to an inch and one half from the top, in a triangular fashion, being careful that the cuts are clean and smooth, not too deep nor yet removing too much wood

The two scions are now selected—firm, healthy, dormant canes, consisting of one to two buds each. They are given a slanting cut on one side through the pith. On the other side a cut is now given to expose the cambium, not through the pith, to form a triangular wedge that fits exactly the excavations made in the stock. (See Fig. 1.)

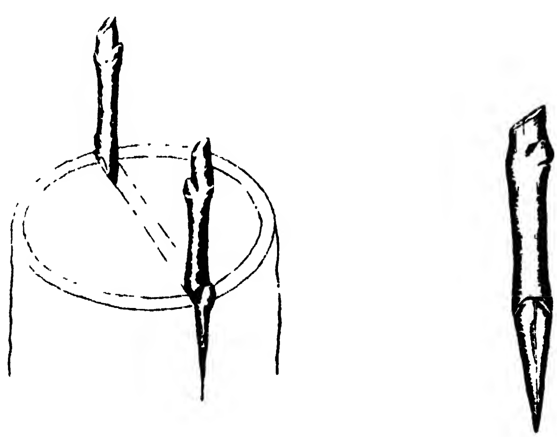


Fig. 1.

The two scions are now inserted, care being taken that they fit perfectly, and that the cambial layers of stock and scion are in close and intimate contact. The wedge is carefully withdrawn and the scions bound with raffia or twine.

It is preferable to bind the grafts, otherwise dislodgments are possible, ruining all hopes of success. After tying, grafting clay is pressed firmly and carefully over the stump to cover the surface of the wound, though this can be dispensed with. Soil is now heaped over the graft to a height of about 15 inches to prevent desiccation and to permit the union to take place. If the soil is very clayey, it is advisable to finish the heaping process with a layer of sand, otherwise the clay may become caked, and the growth of the scions have difficulty in growing through it.

The scions commence growth amidst a profusion of suckers and water shoots, and care must be exercised that the scion is not permitted to play a minor role subservient to such growths. Sometimes if the scion is growing too rapidly a weakness may develop at the union, and in this case it would be wise to allow some sucker growth to take place, or else to pinch out the growing points of the scion shoots.

Fig. 2

The above illustration depicts a Red May grafted on to Muscat of Alexandria. The Muscat was cleft-grafted on the 24th September, 1930, when seven years old. That the graft made excellent growth is evident. Similar growths were obtained from Red Prince, Purple Cornichin, Chasselas and Wortley Hall—all on Muscat stocks.

Fig. 3.

The earth has been removed from the base of the vine, exposing the excellent union, and the tendency of the vigorous scion to establish itself on its own roots.

The cleft graft, however, is difficult when it is desirous of grafting twisted stocks, and the following method overcomes this:—

Grafting by Inlaying.—The stock is cut down in a similar manner to that described under cleft-grafting (Fig. 3).

The implement used to form the inlay, parallel to the long axis of the stock, is a half-inch triangular gouge that forms a clean triangularly-shaped wound an inch or so in length, and from a quarter to a half-inch in depth, on the most projecting side of the stock. If the stock is straight, the inlay is made anywhere just above ground level.

The scion, 14 to 18 inches in length, is cut on one side to fit the inlay by cutting to the pith, to meet another cut exposing the cambial layer, just below the second bud from the top. A hole is then dug to take the length of scion and the graft is secured by firmly tying with raffia. Care, of course, must be taken that the cambial regions of stock and scion are in close and firm contact. The earth is heaped over the stump as for the cleft graft.

The scions for this graft need not necessarily be dormant: a slight bud burst has been successfully used in a Caversham vineyard. Six vines were grafted—five by the above method, and the other by adapting the cleft of the cleft-graft to take the place of the inlay. They were all successful, making vigorous growth that compared more than favourably with neighbouring vines cleft-grafted. The stocks used were muscats, and the scions currants. No misses were recorded—a fault that sometimes occurs with cleft-grafting even if performed in a capable manner. (See Fig. 4.)

Fig. 4.

Fig. 4 shows an excellent example of the currant cutting inlaid into the muscat. The graft was done in September, 1931.

The following, I think, are some advantages that this system of grafting suggests:—

(1) It permits knotted and twisted stumps to be grafted.

(2) On weak-growing vines the stock acts as a nurse, nourishing the scion until it can establish itself on its own roots. The deep planting of the scion enables roots to be formed out of danger from the reach of cultivating implements.

(3) The deep planting of the scion enables it to withstand drying conditions better, the moist subsoil being analogous to the bottle of the bottle graft, keeping the scion moist until the union takes place. Really the scion starts life as a cutting, then as the union is consummated, as a graft, to be followed later by a phase of symbiotic existence, and then ultimately, if required, to establish itself on its own roots.

(4) The scion being so firmly held in the soil proves more difficult to dislodge.

(5) If it is intended that the scion should not establish itself on its own roots, the lower portions can be removed when the union has become safe enough for the purpose.

BOTTLE GRAFTING.

This curious method of grafting (see Fig. 5) can be used at any season of the year, when partially or wholly matured wood is available. It is the only sure means of overhead grafting that we possess, though we have been successful in some overhead cleft-grafts carefully waxed.

Instead of the moist subsoil, the bottle, filled with water, enables the union to take place before drying conditions eventuate to kill the scion. In all cases observed, contrary to deciduous fruit-tree grafting, the bud-burst precedes the callousing over of the union, and it is thus why the overhead working of the vine is so difficult.

The part of the stock to receive the scion is obtained usually on a spur, as close as possible to the main arm.

The scion varies in length from 8 to 10 inches depending upon the depth of the container used. A slanting cut just below the topmost two buds is made reaching to the pith, pointing to the lower extremity of the scion. The edge of the lip is on the outside for a quarter to a half-inch cut to a cambial layer. The stock is now treated in the reverse manner, care being taken to ensure that the lower extremity of the scion will be pointing downwards. The lip of the stock is treated in the same way as that of the scion and the graft is effected by bending back both stock and scion. A firm intimate contact is essential.

The graft is firmly bound with raffia, and a bottle or any container with a narrow neck, permitting a minimum amount of evaporation, is to be used. It is filled with water and fitted over the hanging portion of the scion and fixed securely.

The only maintenance necessary is that the water level should never recede beyond the end of the scion.

The Bottle Graft.—Muscat on Black St. Peter, grafted in March, 1931, although in an inferior position made good growth, and ripened two bunches of fruit. The lower extremity was kept in water until the union was effected. It is now dead and can be removed.

In a suburban garden we obtained excellent results from this graft by performing it in March. In the following Spring a strong healthy growth ensued, and at the end of November the lower portion of the scion was found to be dead. The union was excellent.

This method suggests, if the vine is to be commercially top-worked, that two spurs, as near as possible to the trunk, should be grafted. From these two grafts

subsidiary main arms could be established that when developed enough could take the place of the old. During this time the crop of the vine has not been seriously interfered with.

Fig. 5.

The method involved in bottle grafting is simple and most efficient. The chief criticism is that a fair amount of attention is required filling the containers during the summer months when the vigneron is working at full pressure.

HERBACEOUS GRAFTING.

We have seen excellent examples of this form of grafting.

The vigorously growing cane, when it attains the diameter of one's little finger, is cut with a short, slanting cut about an inch from the basal bud. The scion approximating to the same thickness and at the same stage of maturity is cut in a similar way, leaving only one bud, and placed to fit exactly over the exposed surface of the stock. The graft is then bound with wool or rubber bands. A considerable degree of judgment is required in selecting both stock and scion.

We are not in favour of the method adopted in the grape districts, where the stock, usually old, is cut down during the winter months a foot or so from the ground. During the spring a water shoot—if one is lucky—springs from the stump, and that is the one selected for the operation.

The old stump is then left to the mercy of the weather, roughly hewn, inviting the inroads of fungal parasites and the depredations of white ants.

The utility of this type of grafting, apart from decorative reasons, lies in the same direction as the bottle graft. Spurs situated on the main arms, near the trunk, can be worked over later to take the place of the main arms.

GRAFTING THE FIG.

The fig has generally been regarded in the past as difficult to graft. This we found was not substantiated. The fig is easy to graft (see Fig. 6), but the stock must be vigorous: the callousing process takes a long time, and in weak stocks the scion dies before a union of the surfaces in contact can take place. The chief methods of grafting this tree are—

(1.) *The Cleft Graft.*—Here the graft is overhead and care is necessary that the whole tree is not grafted in the one season, and that the grafts are carefully waxed. In the section on apple and pear grafting the system will be more fully described.

Cleft Grafting—the Fig.—The success of the operation is obvious. The grafts were done in September, 1931, finalising the top-working of the tree commenced in 1930.

Fig. 6

(2.) *Bark Grafting.*—The method involved in this system of grafting will be described in detail later. The same precautions as in cleft grafting must also be observed.

We have obtained equally satisfactory results with both types of grafting. The scion growth has been vigorous, but care is necessary that the profusion of sucker growth does not smother or dwarf the grafts that are usually later in starting growth than other kinds of grafted trees.

GRAFTING THE APPLE AND PEAR.

These are two of the easiest kinds of trees to graft, and the usual method of changing the variety or "top working" is by grafting. The stock of the apple is often propagated by root-grafting, and is practically the only stock treated in this way.

When top working an old tree to change the variety, it is usual to cut the top of the tree back to the secondary arms using a sharp fine-toothed saw. If the tree is very large it may be advisable to spread the operation over two seasons, doing one half of the tree one year, and the remainder the following year. Another method of dealing with large trees is to cut the limbs off at a considerable height and insert the grafts there. This usually means that many extra scions must be used, but it lessens the shock to the tree, and the resulting rapid growth of the scions makes the extra trouble well worth while.

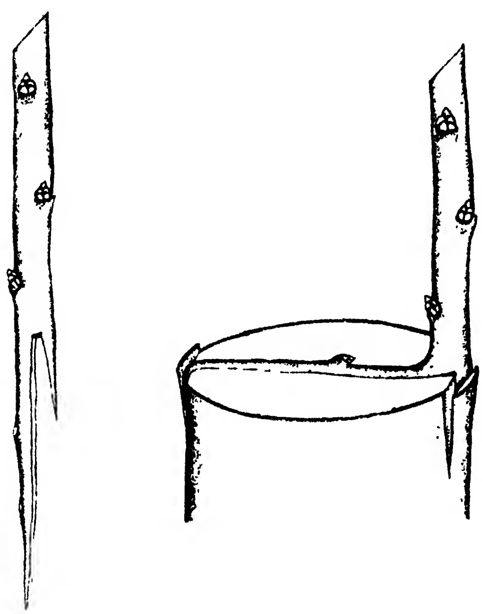
After the tree has been cut back, one must decide which method, or type, of graft should be employed. This is governed largely by the size of the limb or stock to be grafted.

For limbs up to three inches in diameter the cleft-graft gives good results. The chief advantages of this method are that the scions are held firmly in position without the necessity of tying, and that, unlike the bark graft, this method can be done before the bark lifts easily. One disadvantage is that the cleft or crack may harbour disease, but if the work is carried out carefully this possibility is almost negligible.

METHOD OF CLEFT-GRAFTING.

After the stock has been sawn off, trim the rough edges of the bark with the knife, and then with a wide chisel or grafting tool split the limb across the diameter to the depth of 2 to 3 inches. Insert a hardwood wedge to hold the cleft slightly open while the rough edges of the cut are trimmed smooth and to a narrow V shape.

Next, select the scion (usually three buds are sufficient), and cut it wedge-shaped and slightly thinner on the inside. This will ensure a firm pressure being kept where the cambian layers contact. When cutting the scion for this, and all other grafts, make the cut in such a manner that the top or terminal bud will be facing the direction that you wish the graft to grow. When the scion has been cut to fit snugly in the cleft of the stock, insert it in such a manner that the two cambium layers are in contact, then withdraw the hardwood wedge, thus allowing the two sides of the stock to hold the scion firmly in position. Unless the stock is very small it is usual to insert two scions, one on either side of the cleft. When the scions are firmly in place wax over all cut surfaces and the job is complete.



1 2

Fig. 7

1. Showing method of cutting scion for strap grafting.
2. Scion inserted and ready for tying and waxing.

Method of Strap Grafting.—Where the limb of the stock is over three inches in diameter, it is advisable to use the "strap" graft. This method is somewhat more involved than the cleft, but gives very good results, and the cut end of the stock is more quickly healed over. When using the strap-graft the stock is cut and smoothed off in the same manner as when using the cleft.

The scion needs to be a comparatively long one. In gauging the length of the scion, allowance must be made for the diameter of the stock. Allow the usual three buds, the diameter of the stock plus about two inches for the "turn down" on the

opposite side. Thus, to graft a stock four inches in diameter one would need a scion about nine inches long. To shape the scion, make a long sloping cut, starting about three inches below the third bud and cutting one-third of the way through the scion, and to within half an inch of the bud. Then start from the bottom of the scion at the opposite side and cut a thin strip of bark and wood right up level with the top of the previous cut. Then turn the knife a right angles and cut through to the first incision. This will give a scion shaped as per diagram

Now raise the bark on one side of the stock and insert the shorter side of the scion (marked A in diagram), turning the longer side, B, at right angles so that it lies across the diameter of the stock. Bend down the projecting end, and after opening or raising the bark, insert this bent-down portion as shown.

If the edge of the stock is rounded off it will prevent the "strap" from breaking at that bend.

The stock is then bound round with twine to hold the scion in position, and then the whole of the cut surfaces are covered with wax or clay to exclude the air.

Fig. 8.
Apple tree 14 months after top-working. Cleft- and strap-grafts were used.

Fig. 9.
Apple tree second season after top-working, showing vigorous growth of top.

Method of Bark Graft.—Another type of graft often used in conjunction with the "strap" graft on a large limb is the bark graft. This is a very simple graft and consists of merely cutting the scion with a long sloping cut to form a "chisel point." This is then inserted under the bark in a similar way to the two separate points of the strap graft. After tying in place, wax or clay is used to exclude the air.

One big drawback of this method is that until the growing scions have healed on strongly they are very apt to be blown out by the wind.

Method of Whip and Tongue Graft.—If one desires to graft very small limbs, say, up to three-quarters of an inch in diameter, the "whip and tongue" graft may be employed. This is the method generally used in root grafting apple stock. It gives best results when both stock and scion are nearly the same diameter.

The stock is prepared by making two sloping cuts. The first is the downward cut, which should be a little over an inch long, turning slightly with the grain, and cutting about half-way through the stock. The second cut is made upwards, commencing from the opposite side level with the bottom of the first cut, and meeting the first cut, at a very acute angle, near the middle of the stock. These two separate cuts leave a long sloping surface with a wedge like a tongue.

The scion is prepared in a similar manner, but in this case the position is reversed and the upward cut is made first.

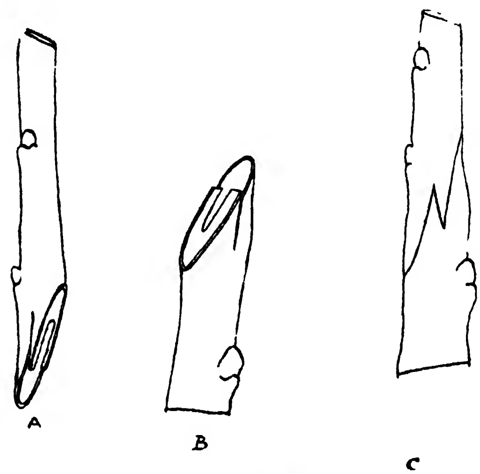


Fig. 10.
Illustrating whip and tongue graft—
(a) Scion.
(b) Stock.
(c) Completed graft ready for tying

The stock and scion are then fitted together, and if they are of the same diameter will form a neat and firm joint with the cambium layers in contact all round. If the stock and scion are not of the same size, make sure that the cambium layers contact on at least one side. The graft is completed by binding with waxed cloth or by tying with raffia and waxing over.

There is another type of graft which is sometimes used—the side graft.

Method of Side Graft.—Where a big tree has been worked high up, the side graft is used to form new laterals or fruiting wood on the old limbs. It is also used to form an extra "leader," where another variety is needed for cross-pollination. In using this method of grafting it is not necessary to cut the stock back as the graft is inserted in the side.

An oblique cut is made in the side of the stock with a thin chisel or a strong knife, and the scion, after being prepared in a similar way to that of the bark graft, is inserted and tied in position. As in all other grrafts care must be taken to see that the cambium layers are in contact.

Where this method is used to form a new leader the top of the stock can be cut off after the graft has taken.

Fig. 11

Graft of Packham's Triumph Pear, which bore fruit during its first season eight pears which matured aggregated $5\frac{1}{4}$ lbs weight

GRAFTING STONE FRUIT.

When top working any of the stone fruits—peaches, plums, apricots, etc., the general practice is to cut the tree back to the secondary arms while the tree is dormant, and then bud the resulting fresh growth during the following summer. A quicker result may be obtained by cutting the tree back during the early spring and grafting in the same manner as when top working apples and pears.

We have seen peach trees worked in this manner make over six feet of growth during the first season, and produce nearly a bushel of fruit the following year. (Fig. 12.) The advantage of this method is that if the grafts should fail the trees always makes sufficient new growth suitable for budding in the usual

Fig 12.

Five-year old peach tree showing vigorous growth during first season after top-working by method of cleft-grafting During the next season this tree carried over three-quarters of a bushel of fruit

manner. Although stone fruit can be satisfactorily top-worked we do not recommend this operation on trees that are over twelve years old. The grafts will probably take alright, and may produce quite a good tree, but the cut stump is usually

very slow in healing over. Dry Rot and even white ants are very liable to gain access and so weaken the stump, that when the rejuvenated top is carrying a nice crop of fruit the main limbs will break down and the tree is ruined.

Most varieties of stone fruits may be worked one on to another, *i.e.*, plums on to peaches, and *vice versa*, but it is generally safest to keep the plum stocks only for plums. English plums top worked on Japanese plums and the reverse operation are not always satisfactory. The peach stocks gives good results all round, but especially as a stock for plums and apricots on light soils.

Care must be taken when working English plums on to peaches, for some varieties do not make a good union. The Grand Duke, for instance, seldom unites satisfactorily. It generally grows vigorously, but there is always an unsightly bump where the union has taken place.

Where it is desired to work the "Grand Duke" on to a peach stock, it is necessary to double work the tree to get a neat union. The peach is first worked with a variety such as the "President," which will make a good union, and then the "President" is later worked over to the "Grand Duke."

Peaches and plums generally take well on to almond trees, and we have had good results when top-working apricot trees with peaches and Japanese plums.

The same types of grafts as used for the apple and pear may be employed in grafting the stone fruits.

GRAFTING CITRUS.

Citrus trees may be top-worked like any other kind of fruit tree. Although budding is generally employed for this operation we have had excellent results with grafting. As with top-working other varieties of trees, if the grafts happen to fail one can always resort to budding later on in the season.

In grafting citrus it is advisable to cut back only about half the number of limbs during the first year so that sufficient top is left to shade the main limbs which are very prone to sunscald. The remaining limbs may be cut back and grafted during the following year. This method also allows one to harvest a portion of the usual crop for a season after the first grafts are inserted.

Best results are obtained by grafting citrus early in October just before active growth commences, and before the weather becomes too hot.

The cleft-graft, as described for the apple and pear, is very successful for top-working the orange. The scion should be cut from good round wood of one to two years old and should be about the thickness of a lead pencil.

Another graft which may be used with good results is the "Crown" graft, as used when grafting the grape vine. In this case the main trunk is cut off at ground level and several scions are inserted, either the "cleft" or the "bark" graft may be used. The whole lot is then covered with soil leaving only the top buds protruding. After growth commences all but one—the most suitable scion—are removed. The selected one is then trained as a new tree. This method has a serious drawback in that the sawn-off stump left in the ground is liable to rot, and to harbour the Armillaria fungus, which is a serious trouble with citrus.

Bridge grafting and inarching are two special modifications of the practice of grafting.

Bridge grafting, as its name implies, is generally used for bridging over any extensive injury to the bark of the trunk or main limbs of a tree.

Fig. 13.
Poor affinity. Grand Duke worked on peach stock. To prevent this it is necessary to double-work the stock.

Fig 14
Thirty-year old orange tree eighteen months after being top-worked by means of cleft-graft

Fig. 15.
Five-year old peach tree inarched to renew part of root system destroyed by Armillaria.

The operation is performed by taking a scion—usually the same variety as the tree being treated—several inches longer than the length of the injury to be bridged. The scion is shaped at both ends in the same manner as when doing the bark graft. An opening is then made an inch or so below the injury by making a "T" cut through the bark and raising the two edges. A similar opening is made just above the injury by making an inverted "T" incision.

The scion is then bent bow fashion while the two ends are inserted in their respective openings. The scion is then allowed to straighten and the shaped ends are forced into position under the bark with their cambium layers in contact with the cambium of the stock. The graft is then tied in position and covered with wax or clay.

If the operation is being done before the sap is moving, *i.e.*, before the bark lifts readily, the scion may be inserted by making an oblique cut through the bark into the wood instead of the "T" incision. One must then use extra care to make sure that the cambium layers are in contact.

Bridge grafting has its special value in saving trees that have been partly or wholly ringbarked by bark-eating animals, or by the attacks of fungus diseases such as Collar Rot and Fire Blight. It is quite safe to bridge-graft any injured tree provided the bark is healthy immediately above and below the injury. In the case of a large injury, two or more scions may be inserted so that there will be less check to the normal flow of sap.

Where a tree has had a severe injury to the trunk and there is no healthy bark below the injury, the tree can often be saved by "inarching." This operation consists of planting a young tree, or cutting, close to the trunk of the injured tree and then grafting or inarching it into the healthy trunk above the injured portion. The method of operation is similar to that of inserting the top end of the scion when bridge-grafting.

The young tree or cutting must be planted during the dormant season. Although the inarching is best left till both trees are showing signs of growth, we have had good results with inarching apple-trees at various times between August and November. The scope of inarching is much wider than that of "bridge grafting," for it may be used not only in case of injury to the trunk, but also, if necessary, to give a tree a complete new rooting system perhaps of a different variety from its original system.

Fig. 15 shows two peach seedlings inarched into a five year old peach-tree in an attempt to renew part of the rooting system which was destroyed by Armillaria.

Fig. 16 illustrates the trunk of an eight year old "Granny Smith" apple-tree which, after being blown down by a gale last autumn, was inarched to strengthen the rooting system on the weaker side. In this case, again, two inarches were made. The one on the right hand is a Northern Spy "whip," while the one on the left is a portion of Northern Spy root of about five-eighths of an inch in diameter.

The trees in both these illustrations have been benefited by inarching and appear to be on the way to recovery.

CONCLUSION.

Apart from the commercial systems of grafting, there are many types of fancy grafts that can afford much pleasure to those interested. The various forms of grafting by approach can increase the size of show fruit and can interlock trees and branches together into fantastic shapes. The procedure of the grafting operations is similar to the method described previously under inlaying the grape vine or under inarching.

Fig. 16.
Eight-year old Granny Smith apple tree inarched to strengthen rooting system On the left shows piece of root inarched, on the right is young Northern Spy whip.

In conclusion, we would like to emphasise that for successful grafting one must carefully observe—

(a) The condition of the tree or vine—if too old, or diseased in any way, it is preferable to use fresh plantings.

One sometimes sees instances of old trees grafted. For a time the scions make vigorous growth until the previous balance between the roots and the aerial portion is reached. The tree then relapses into its former condition of senility.

(b) The affinity between stock and scion. This must be ascertained from an authoritative source.

(c) *Method.*—Whatever method of grafting is used the work must be done carefully, and the cambial layers of stock and scion must be in close and intimate contact.

(d) *Season.*—The tree or vine must, together with the scions, be chosen at the right stage of development.

(e) That care of the growing scions is necessary for successful results.

The following quotation from Shakespeare very aptly illustrates the fact that man, by careful attention to Nature's rules, can assist and initiate the work performed by her, but the completion of the work is Nature's, and Nature's alone.

"You see, Sweet Maid, we marry
A gentle scion to the wildest stock:
And make conceive a bark of baser kind
By bud of nobler race: this is an art
Which does not mend Nature: change it rather: but
The art itself is Nature."

TURKEYS IN WESTERN AUSTRALIA.

A. C. JENYNS, Poultry Adviser.

Turkey rearing is coming so much to the fore this season that the growing demand for quality is causing breeders to take notice and improve their stock with a view to better markets. The fact of a possibly large market overseas has caused a large increase in the possibilities of turkey farming. In the past turkeys have only been a necessary evil on most wheat farms, being sent into market in very poor condition, with resulting low prices. To turn this branch of industry into a profitable side line there are a few leading points to consider:—

1. Good stock to start breeding.
2. Free range on good clean land.
3. Plenty of green feed.
4. Comfortable housing.

The breed most suited to our conditions is the Bronzewing; it is of good size and of a hardy nature.

The stock birds should be chosen from breeders whose flocks and premises are free from disease. The importance of this is that once disease is brought on to the farm, it is very difficult to eradicate (Black Head and Coccidiosis are the two most serious diseases with turkeys, both being diseases that get into the soil and cause trouble year after year). The best breeding results will be obtained with well-developed second-year hens mated to a good young gobbler. Breeding with immature birds is the cause of a large percentage of trouble and difficulty in rearing the young stock which, even if reared, will not give satisfactory results.

In choosing the male bird for breeding purposes, one with length and breadth of body, deep breasted, straight breastbone, and not too long in the leg is the type most suitable for table birds. When the birds are mated one gobbler to 6 or 8 hens is sufficient, as one visit from the male fertilises the whole sitting of eggs laid by the hen.

Hatching should be done in the warmer months as young turkeys are very easily chilled, which results in lung congestion and severe diarrhoea, the best remedy for which is one drop of chlorodyne in a teaspoonful of water every three or four hours. Wetness and cold are the chief enemies of turkeys, and I am sure that if turkeys are kept warm and dry there will be little or no disease enter the flock.

Feeding should be carried out just as carefully as with poultry. A wet mash consisting of two parts pollard, one part bran, and 2½ per cent. bone meal is the best morning meal, with free range all day, and wheat at evening. It must be remembered that turkeys cannot be correctly primed without abundance of green feed. For the chicks, eggs, including the shell, crushed with stale bread and bran and pollard in equal parts, is a good feed up to 6 to 8 weeks old; after 6 weeks the mash given for the old birds can be fed. Cod liver oil added to the mash at the rate of 1 teaspoonful to 6 birds till 12 to 14 weeks will make a great difference in the development of the young stock; where the mash can be mixed with skimmed milk, the best results are obtained. Mashes should be moist, not wet.

Turkeys are a good marketable proposition on the local market if they are really prime. The possible development of an overseas market for dressed poultry will add to the interest of breeders of turkeys as there is, and will always be, a large demand for prime dressed turkeys. Size and fatness are the most important points, and these can only be had by careful selection of the breeding stock and proper feeding.

THE M. T. PADBURY TROPHY COMPETITION.

I. THOMAS, Superintendent of Wheat Farms.

This competition, which has been conducted for the past two years, was inaugurated as the result of a generous donation made by Mr. M. T. Padbury, President of the Primary Producers' Association, a past President of the Royal Agricultural Society and a prominent pioneer farmer of this State.

The allocation of the funds has been so arranged that a replica of the main shield is awarded to the winner each year of the competition, *i.e.,* the competitor who produces the highest acre yield of wheat per inch of rainfall during the growing season (May 1st to October 31st).

The conditions under which this competition is being conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed from the results of the five seasons in which the competitor produced the highest acre yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year, and until further notice, it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms, he will be required to supply details regarding the production and marketing of the crops on same, and, though usually the award will be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain, and determined from the actual amount of wheat sold as shown by the delivery dockets, plus the amount retained for seed, for home use or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The acre yields obtained, although not quite as high as last year, when an official State record of 3 bushels 23lbs. per inch of rainfall was established by Mr. F. A. Williams, of Mangowine, are nevertheless highly meritorious. It is interesting to note that the general standard in the competition has been maintained. The average yield per inch of rainfall for last year was 2 bushels 11 lbs., and for the previous year 2 bushels 13 lbs.

The results for last season, the second in the competition, are set out below:—

M. T. PADBURY TROPHY COMPETITION 1931

Competitor	Address	Rainfall during growing period	Area harvested.	Yield				
				Gross	Average per Acre		Average per 1in growing period rain	
		points	acres	bushels	bus	lb	bus	lb.
Atkins, F. M. and J. L.	Jouerdine	648	375	7,291	19	27	3	0
Moore, T.	Indarra	1,134	242½	7,677	31	39	2	47
White, R. H.	Gnowangerup	1,170	270	8,662	32	5	2	45
Stewart, W. B.	do.	1,170	200	6,131	30	39	2	37
Nottage, R. B.	Tammin	1,098	289	8,250	28	33	2	36
Smith, C. & Sons	Yarding	942	2,294½	53,686	23	24	2	29
Leah, J. & Sons	Bruce Rock	1,034	310	7,823	25	14	2	26
Williams, F. A.	Mangowine	836	319	7,044	20	11	2	25
Harris, E. G. S.	Mukinbudin	850	443	9,058	20	27	2	24
Allen, Bros.	Bruce Rock	1,036	753	18,581	24	41	2	28
Barnett, L. T. C.	Walgoolan	1,022	399½	9,433	23	37	2	19
Stevens, G. K.	Ghooli	804	203	3,766	18	33	2	19
Creagh, Bros.	Kwelkan	987	991	22,154	22	21	2	16
Beeck, H. O.	Gnowangerup	1,170	418	10,585	25	19	2	10
Bremner, J. R. & Sons	Corrigin	1,082	980	22,923	23	23	2	10
Mannel, C. J.	Mukinbudin	850	410	8,073	18	21	2	10
Horsman, H. & Sons	Bilbarin	1,082	356	8,062	22	39	2	6
Strange, P.	Yarding	1,034	398	8,660	21	46	2	6
Garnett, J.	Gnowangerup	1,170	262	6,417	24	24	2	5
Bothe, B. D.	Coorow	1,205	562½	13,806	24	33	2	2
Smith, C. and A. H.	Bruce Rock	1,082	1,127½	24,692	21	54	2	1
Cusbert, L. C.	Bruce Rock	1,082	402	8,573	21	19	1	58
Cuming, A. S.	Carnamah	1,497	323½	9,410	29	5	1	57
Riches, H. & Sons	Wyalkatchem	1,114	604	12,995	21	31	1	56
Finklestein, H.	Shackleton	1,055	524	10,616	20	16	1	55
Kingston, D. W.	Boodarockin	808	296	4,217	14	15	1	46
Richardson Bros.	Bonnie Rock	858	392	5,232	13	21	1	33
Carter, J. S.	Benjabbering	1,114	297½	4,337	14	35	1	19
Carter, H. R.	Three Springs	1,367	496	7,697	15	31	1	8

THE CANARY GRASSES OF WESTERN AUSTRALIA.

C. A. GARDNER, Government Botanist, and G. R. MEADLY, B.Sc.

The species of *Phalaris* dealt with hereunder are not all naturalised or cultivated in Western Australia on a large scale, but those species which are either naturalised, cultivated or at present being experimentally grown are included. The purpose of this paper is primarily intended for the determination of such species, hence the key to the species, and the more or less detailed descriptions of each. The incidental notes contain what may be of importance concerning the economics of each species, but our knowledge of the species of this genus is at the present time meagre.

The genus has attracted much attention during recent years because of the value of some of the perennial species as pasture plants. They have been shown, especially *Phalaris tuberosa*, to be valuable species because of their nutritive value,

hardiness, and adaptability to various soils, their permanency, and the quality of the sward produced, and, especially with *P. tuberosa,* the rapidity and seasonal incidence of their growth. Thus *Phalaris tuberosa,* the Toowoomba Grass, has come into favour in districts such as South-Western Australia, where it promises to become one of the principal constituents of our permanent pastures.

The Canary Grasses are so named because at least one of the species (*P. canariensis*) provides the canary seed of commerce. *Phalaris minor* shares in this to some extent also, but is usually an adulterant. While the former is largely grown in other countries for its birdseed, the species is not cultivated for this purpose here but is a naturalised alien which is spreading in several parts of the South-West of the State.

The species dealt with here may be classed regarding duration of life, status and uses, as follows:—

Annual species:

- *P. canariensis.*—Naturalised alien, not, or little, cultivated, usually a weed of sandy soils.
- *P. minor.*—Naturalised alien, also cultivated, but usually in mistake for *P. tuberosa.*
- *P. angusta.*—Naturalised alien established near Guildford, a species which promises well for salt areas.
- *P. paradoxa.*—Naturalised alien not yet well established Of no known economic value.

Perennial species:

- *P. tuberosa.*—Introduced species being planted in permanent pastures in the South-West.
- *P. caerulescens.*—Species at present being experimentally grown, suitable for cultivation in the South-West.
- *P. arundinacea.*—Introduced species at present being experimentally grown, suitable for wet lands.

The genus contains about 20 species, of which five are of importance, four of them being pasture plants and one grown for seed. All of these are at present being tried out experimentally with the single exception of *Phalaris caroliniana,* a North American species which is an important perennial species grown for forage in the Southern United States of America. It is apparently closely related to *P. augusta.*

PHALARIS, Linn.*

Spikelets with one perfect flower, compressed, densely crowded into a simple or lobed spikelike panicle. Rachilla disarticulating above the glumes; florets 1-7, of which only one is fertile. Glumes persistent, longer than the florets, keeled and often complicate, the keel usually produced into a dorsal hyaline wing, or sometimes the wing vestigial. Florets usually 3, the two lower reduced to sterile lemmas, sometimes equal, sometimes one small and scale like, or both minute, or (in *P. caerulescens*) absent. In *P. paradoxa* there are 6 sterile florets which are comparatively large, variously shaped, and form an involucre to the fertile floret. Fertile lemma lanceolate-ovate, compressed laterally, muticous, usually becoming subcrustaceous in fruit, silky hairy or glabrous, pale-coloured. Palea about as

*Derivation obscure, but probably from φαλαρος—meaning "white crested," an allusion to the white wings of the glumes.

long as the lemma, included within its margins after flowerng. Stamens 3. Style distinct, the stigmas plumose. Grain oblong, included in the lemma and palea but free from them.

Inflorescence a short or long usually dense and spikelike panicle, white or variegated green and white (assuming a violet tint in *P. caerulescens*) with green nerves, often papery at maturity.

Annual or perennial grasses with flat leaves and hyaline culm-embracing ligules, mostly native to the Mediterranean and neighbouring regions.

KEY TO THE SPECIES.

A.—Spikelets of one kind, each with one fertile floret.

a Keels of the glumes distinctly winged; panicle compact, spike-like or ovoid.

α. Panicle ovoid, rarely oblong, usually almost as broad as long; glumes with broad oblique wings; sterile lemmas more or less equal, more than half as long as the fertile lemma ... ... 1. **P. canariensis,** *Linn.*

β. Panicle oblong to cylindrical, often narrow; wings of the glumes not broad; sterile lemmas unequal, sometimes one or both absent, less than half the length of the fertile lemma.

I. Wings of the glumes entire or minutely serrate: at least one sterile lemma present; spikelets green and white, acute or shortly acuminate.

1 Only one sterile lemma present, the outer represented by a minute callous scale or entirely absent: outer glumes acute, often irregularly serrulate or fimbriate; annuals with fibrous roots; fruit acutely ovate ... ... 2. **P. minor,** *Retz.*

2 Both sterile lemmas developed, the longer one-third as long as the fertile lemma, the other smaller: glumes obtusely acute, entire; perennials with swollen basal nodes; fruit acutely ovate-elliptical ... 3. **P. tuberosa,** *Linn.*

II. Wings of the glumes irregularly and deeply toothed, the glumes acuminate or almost awned; sterile lemmas obsolete: spikelets purplish-violet. Perennials. ... ... 4. **P. caerulescens,** *Desf*

b Keels of the glumes not winged, or the wings obscure and very narrow: sterile lemmas narrow, hairy, more or less equal, less than half as long as the fertile lemma.

α. Panicle narrow-cylindrical: glumes obtuse, serrulate on the keel. Annual plant. ... ... 5. **P. angusta,** *Nees.*

β. Panicle broader, often branched or lobed; glumes acute, not serrulate on the keel. Perennial plant with creeping rhizomes ... ... 6. **P. arundinacea,** *Linn.*

B.—Spikelets of two kinds, the terminal fertile spikelet surrounded by a group of 6 (rarely fewer) sterile variously shaped spikelets which fall off entire with the terminal spikelet; fertile glumes acuminate with a dorsal more or less falcate wing; sterile lemmas minute equal. ... ... 7. **P. paradoxa,** *Linn.*

1. *Phalaris canariensis,* Linn. "Canary Grass."

An erect leafy annual of 2-4 feet in height with fibrous roots. Culms ascending or erect, branching in the lower parts, sheaths loose, shorter than the internodes, striate. Ligule membranous, truncate. Leaf-blades flat, rather broad, tapering into long fine points, striate. Panicle ovoid to ovoid-oblong, dense, the glumes

sharply keeled, flat, lanceolate, acute, prominently 3-nerved, the margins broad, thin and hyaline, the dorsal wing narrow in the lower half then gradually broadened in the upper half into a broad conspicuous wing which tapers off abruptly at the apex which is shortly acute. Sterile lemmas not very unequal, more than half as long as the fertile lemma, conspicuously nerved and somewhat keeled, appressed to the fertile lemma, scarious, glabrous or pubescent, the apex tufted with short white hairs. Fertile lemma laterally compressed, 5-nerved, silky-villous, acute, ovate to ovate-elliptical, more than half the length of the glumes; palea smooth keeled, minutely truncate and ciliate fringed.

Native to the Mediterranean Region, Northern Africa, Central Asia, and the Canary Islands.

The species may usually be distinguished by its short ovoid head. Occasionally, however, it is longer and oblong, approaching that of *P. minor,* from which it can always be distinguished by the broader wings of the glumes, broader "seeds" and the large sterile lemmas which serve to distinguish it from all other species.

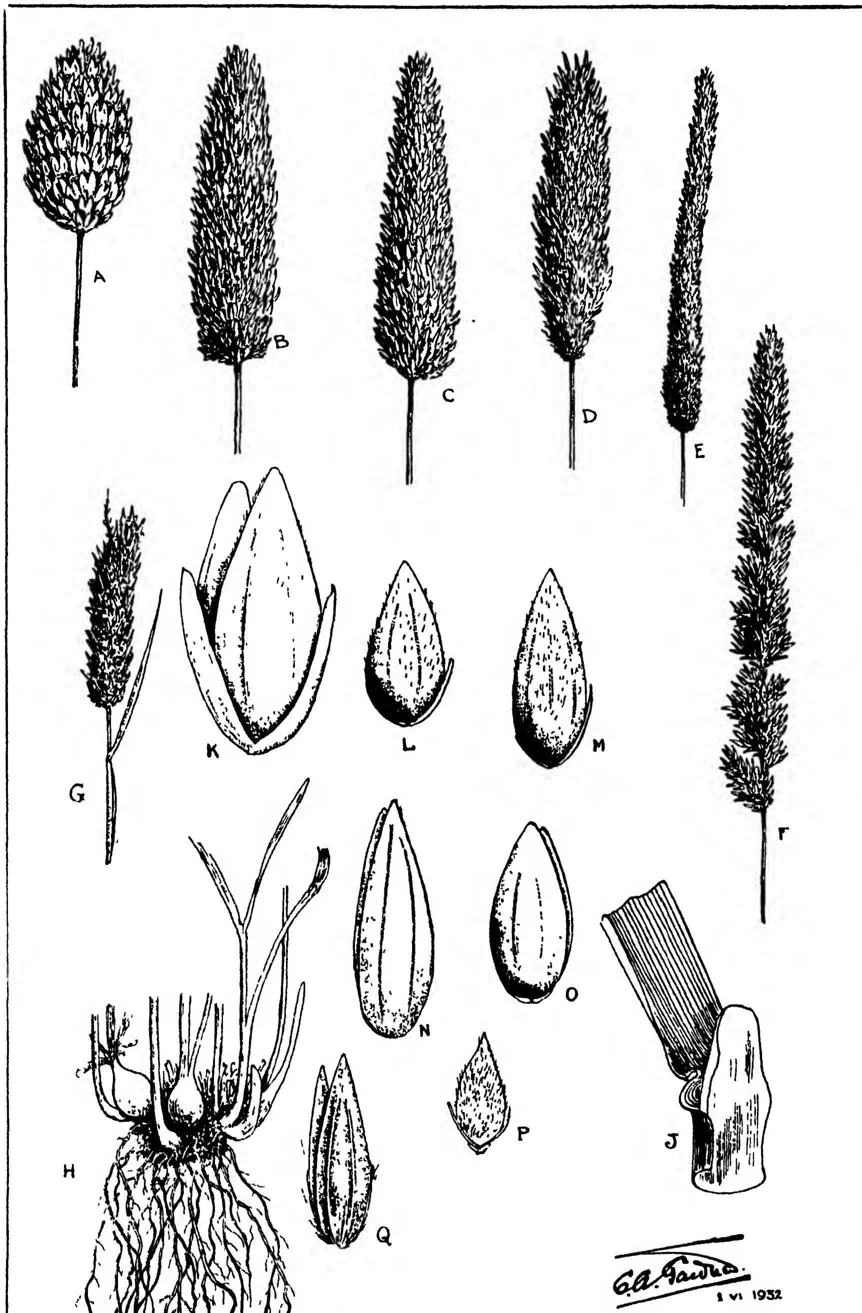
Phalaris canariensis is much cultivated in Mediterranean countries, and in Queensland, for its seed which is the Canary seed of commerce, but this usually contains also the fruits of *Panicum miliaceum,* one of the Millets. True Canary seed is light yellow in colour, about 5mm. long, ovate-elliptical in outline, laterally flattened but equally convex on both surfaces, hard, shining and pubescent, whereas the seed of *Panicum miliaceum* is pale brown or reddish, of about the same size as the former, but much more plump and distinctly flattened on one side only.

This species is naturalised in Western Australia, but is nowhere gregarious. It is met with mostly on the lighter types of soil, especially in coastal districts. Stock eat it readily when green, but it does not produce much bulk, being always erect and slender. As a crop plant it is stated to be exhaustive, and for this purpose requires a rich friable soil. The flour made from the seeds is used in certain processes of cotton manufacture.

2. *Phalaris minor,* Retz. "Lesser Canary Grass."

An erect leafy annual with fibrous roots. Culms tufted, erect or ascending, usually geniculate near the base, 1 to 3 feet in height, finely striate. Leaf-sheaths shorter than the internodes, the lower tight, the upper loose and inflated, striate. Ligule white, hyaline, delicate, up to one-quarter of an inch in length. Leaf blades linear, gradually tapering into long fine points, flat, flaccid, hairless, smooth or nearly so. Panicle spikelike, oblong to cylindrical, broad, up to two and a half inches long, compact, the spikelets usually spreading, the panicle usually abrupt at the base; peduncles ultimately exserted from the sheaths. Glumes subequal, lanceolate, acute, 3-nerved, the nerves prominent, the margins broad, hyaline but firm, the dorsal wing prominent, gradually broadened from about one-third the length of the glume upwards, broadest at two-thirds of its length, then more or less gradually narrowed to the apex, minutely serrulate, and often with a few slight indentations or notches, or almost entire. Sterile lemmas reduced to an upper one which is less than half the length of the fertile lemma, linear-lanceolate, firm and sparsely hairy, closely appressed to the fertile lemma, the lower one represented by a minute callous scale, or entirely absent. Fertile lemma sparsely silky-hairy, acutely ovate about half the length of the glumes; palea obtusely acute, apparently one-nerved and more or less keeled, ciliate on the keel and minutely tufted at the apex.

Native to the Mediterranean Region but introduced into most temperate countries, and sometimes regarded as a weed. In its structure it closely resembles



PHALARIS, Linn.

PLATE I.

P. tuberosa, from which, however, it can usually be distinguished by the more acute glumes, abruptly based panicle, but more particularly by the broader fruits and the presence of only one sterile lemma. The seed is either pale yellow or brown in colour.

Phalaris minor is established widely throughout the South-West. In some localities it has been planted as *Phalaris tuberosa* in error. It is now well established as a naturalised alien as far east as Merredin, principally on the low-lying heavy clay flats subject to winter inundation. It is in such soils that it appears to make the best growth, attaining a height of 2 to 3 feet and tillering vigorously. It is a very nutritious grass, and should be worth cultivation in areas which are too dry for the maintenance of *P. tuberosa,* especially if grown with Wimmera Rye Grass. It makes good early winter growth and remains green until late into November. The species has a relatively high gluten, gum and sugar content.

3. *Phalaris tuberosa,* Linn. (*P. bulbosa,* Linn.; *P. nodosa,* Linn.).

Perennial, caespitose, the culms more or less swollen at the basal internodes, or forming hard woody stocks, 2-4 feet in height, erect or ascending, sometimes geniculate below. Sheaths much shorter than the upper internodes, tight and striate; ligules long, thin, white and hyaline, truncate and soon becoming lacerated. Leaf blades firm, rather soft, prominently striate, tapering into long, weak, fine points. Panicle cylindrical, spikelike, up to five and a half inches in length, compact, tapering at both ends or sometimes broader at the base, the spikelets usually erect, the peduncles ultimately long exserted.

Glumes subequal, lanceolate, rather straight, more or less acute but not long-pointed, 3-nerved, the lateral nerves prominent; margins wide, hyaline but firm, keeled, flat, the keel produced into a prominent dorsal wing extending over the upper two-thirds of the glume and gradually narrowed at each end, minutely serrulate or entire and not notched. Sterile lemmas not very unequal, the lower about one-quarter, the upper one-third the length of the fertile lemma, both sparsely hairy and appressed to the fertile lemma, more or less linear and concave. Fertile lemma acutely ovate-elliptical, silky with appressed hairs, faintly nerved, becoming firm in fruit; palea acute, slightly less in length than the fertile lemma, glabrous except for the terminal tuft of a few short hairs.

Mediterranean Region, but now introduced into many temperate countries, and known in Australia as "Toowoomba Canary Grass." This species is sometimes referred to as *P. bulbosa,* a name which is now held to be invalid, since it was applied by Linnaeus to a species of *Phleum.* Another invalid name given to the plant was *P. commutata,* a "species" which was probably described from mixed material. *Phalaris stenoptera,* a name given originally to specimens received from Victoria, is at the present time recognised by American botanists. The species is said to differ from *P. tuberosa* in the narrower wings to the glumes, the absence of the first sterile lemma (as in *P. minor*), and in the basal internodes not being swollen. An examination of the material by Stapf showed that the sterile lemmas were identical with those of *P. tuberosa,* and it has been observed locally that the swelling of the internodes is a variable character, being more pronounced in some strains than in others. The character of the breadth of the wing is not definite enough for a specific character. *Phalaris nodosa,* of which we have not seen flowering material, appears to be a narrow-leaved form of *P. tuberosa* with markedly swollen basal internodes.

Phalaris tuberosa is a grass which has proved one of the most hardy of our introduced perennial species. It was grown successfully some years ago at Kool-

berin, the property of Mr. W. N. Hedges, and in the Perth Experiment Plots carried through the summer, even producing fair growth during the driest months, in sandy soil. It is eminently suitable for places where the soil is moist throughout the summer, and under such conditions should provide abundance of feed through the year. Planted from seed it is slow in establishing itself, and for this reason if planted in a mixture, it should be grown with such species as Wild White Clover and "Cocksfoot" (*Dactylis glomerata*), or the Cocksfoot may be added during the second year. Once established, it makes vigorous growth after grazing or cutting either during the summer or the winter.

4. *Phalaris caerulescens*, Desf.

A perennial species with the habit of *P. tuberosa*; culms erect from a hard stock, 2 feet or more in height. Leaf-sheaths shorter than the internodes, tight and prominently striate. Leaves as seen, short, straight and striate; the ligule broad, white and hyaline, obtuse.

Panicle oblong-cylindrical, shortly tapering at both ends, dense, purplish-violet from the colour of the upper portions of the glumes, simple, the peduncles long exserted.

Glumes subequal, lanceolate, tapering into an acuminate almost awned apex, 3-nerved, broad and hyaline, rather firm; dorsal wing well developed, irregularly toothed or lobed, gradually broadened from about one third the length of the glume and entire for some distance above the middle, then terminating abruptly in an irregularly lobed appendage, or continuing to the apex, but always irregularly toothed or lobed in the upper part. Sterile lemmas not developed. Fertile lemma about half as long as the glumes, elliptical in outline, acute, glabrous, smooth and rather prominently nerved: palea equal to the lemma in size or slightly smaller and much narrower.

Native to the Mediterranean Region.

The species can be readily distinguished from *P. tuberosa*, to which it is most closely related, by the toothed wings of the glumes, the purplish cast of the panicle, and by the undeveloped sterile lemmas.

The species is not widely cultivated, but is at present reseiving some attention.

5. *Phalaris angusta*, Nees.

An annual with fibrous roots. Culms erect, slender, straight and tall, with few nodes, prominently striate. Leaf-sheaths loose, purplish, shorter than the internodes; ligule broad and hyaline, truncate; leaf blades linear, tapering from a broad base to a long fine point, flat, smooth, many-nerved, 3-6 inches in length.

Panicle narrow, two to two and a-half inches in length, resembling that of Timothy grass (*Phleum pratense*), and about one quarter of an inch in breadth, the peduncles slender and much exceeding the uppermost leaves.

Glumes small, 3-nerved, subequal, oblong, muticous, the margins and keel parallel, the hyaline margins rather broad, the keel not winged or only obscurely so in the upper third of the glume, itself and the rudimentary wing finely toothed. Sterile lemmas linear, hairy, subequal, about half as long as the fertile lemma and closely appressed to it. Fertile lemma ovoid-elliptical, rather more than half as long as the glumes, silky-hairy; palea similar but narrower.

Native to America:—United States, Brazil, Peru and Argentine.

The species is most closely related to *P. arundinacea* with which it agrees in having the dorsal wing of the glume undeveloped. It can be distinguished from *P. arundinacea* in its smaller narrow "Timothy"-like panicle, obtuse glumes, and its

annual habit. This grass is naturalised around Bassendean in a salt swamp growing with *Calamagrostis filiformis* and *Polypogon monspeliensis* as an annual of 4 to 5 feet in height. The species should probably be found useful in swampy or sub-swampy areas where salt is present in the soil. It is very closely related to ***P. caroliniana***, Walt., the "Apache Timothy" of the Southern United States, a perennial which is said to be an excellent grass for winter and spring grazing.

6. *Phalaris arundinacea*, Linn. "Reed Canary Grass."

A perennial with short creeping rhizomes and firm scarious sheathing scales. Culms erect from a creeping or ascending base, 2-4 feet or more in height, rooting at the lower nodes, simple or scarcely branched, firm and tough, finely striate. Sheaths glabrous, smooth, strongly striate, the lower tight, the upper looser and shorter; ligule hyaline, white, obtuse, up to one-quarter of an inch in length. Leaf-blades linear to linear-lanceolate, gradually tapering into long points, 6-12 inches long, rigid, glabrous, glaucous and smooth, many nerved.

Panicle erect, sometimes nodding, spike-like or lobed, up to 8 inches in length, copiously and densely branched.

Glumes subequal, whitish green or purplish, acute, 3-nerved, lanceolate, tapering into a long acute point, the margins rather broad, the keel not winged or the wing obscure towards the apex of the glume, minutely serrulate. Sterile lemmas subequal, lanceolate to subulate, obscurely 1-nerved or nerveless, hairy with a callous base, slightly less than half as long as the fertile lemma. Fertile lemma half as long as the glumes, lanceolate in outline, dark purplish-brown, acute, sparsely silky-hairy with long hairs, palea ciliate on the back.

Mediterranean Region, Africa, Asia, and North America.

This species somewhat resembles *P. tuberosa* and *P. caerulescens*, but differs from both in its unwinged glumes and stoloniferous habit. It is structurally more closely related to *P. angusta*, an annual species, from which it can readily be distinguished by its acute glumes, broader panicle which is sometimes (not always) lobed or widely branched, and by its vegetative habit.

The Reed Canary grass is a species which thrives in shade or in wet swampy land subject to inundation, but will also grow on rather dry sandy soils where the water table is sufficiently high. The strong rhizomes creep extensively, making the grass particularly valuable for binding the banks of streams or drains. It does not attain its full development until the second year. The mature culms are somewhat woody, so that the grass should be kept well grazed, or if grown for the purpose of hay should be cut before flowering commences.

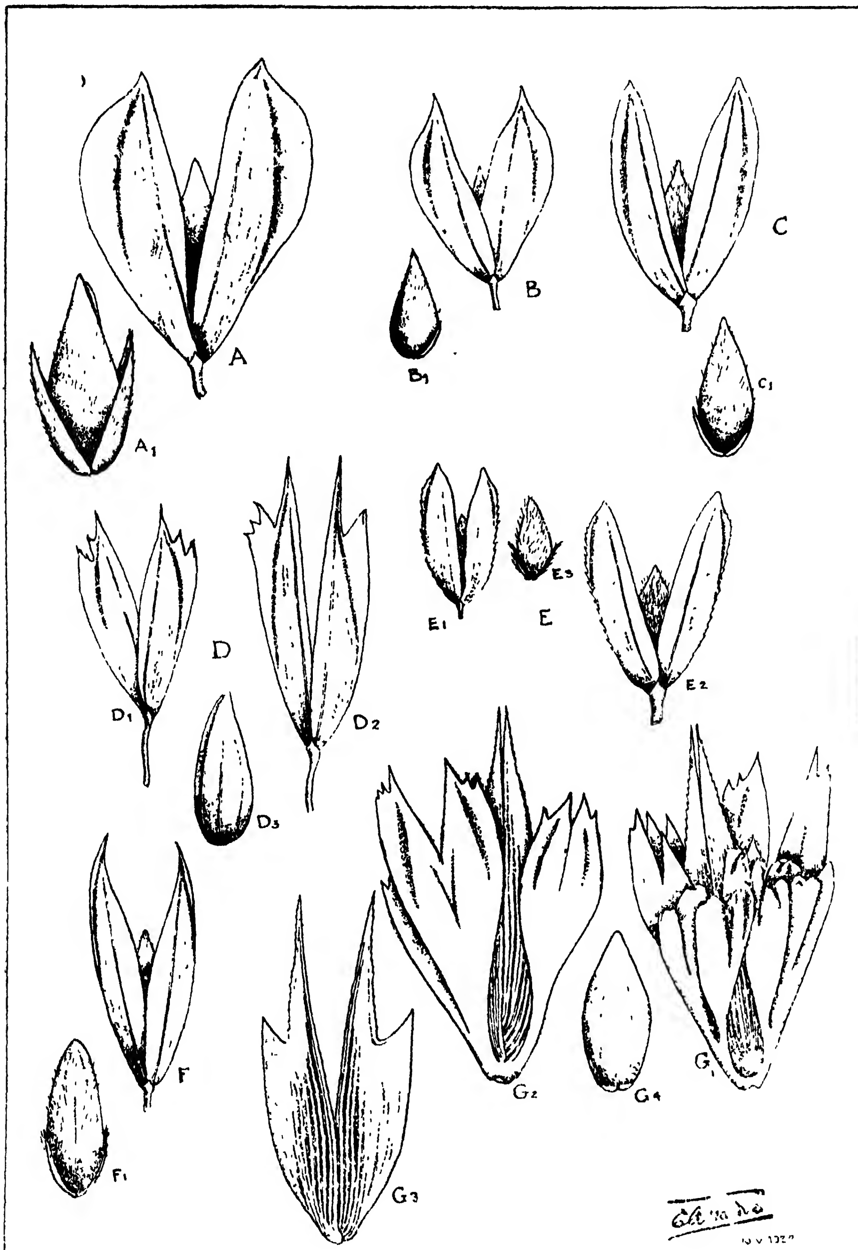
A variety of this species (var. *picta*), with leaves striped green and white, is cultivated in gardens under the name of "Ribbon grass."

7. *Phalaris paradoxa*, Linn.

Annual with fibrous roots; culms erect, rather slender, purplish near the nodes, striate, one to two and a-half feet in height. Leaf sheaths rather loose, the uppermost inflated; ligule long, membranous, white. Leaf-blades narrow, straight, gradually tapering to a fine point from a broad base.

Panicle cylindrical, compact, the spikelets densely crowded, the branches short and straight, the panicle narrow and about one and a-half inches in length.

Fertile spikelet terminal on the secondary branches of the panicle, surrounded by an involucre-like group of six sterile spikelets of unequal size, although two are usually much larger than the others, each consisting of complicated glumes enclosing a sterile lemma with an abortive anther, or empty. Glumes of the fertile spikelet subequal, acute or acuminate, hard, many-nerved, straight, keeled with a dorsal



PHALARIS, Linn.

PLATE II.—Details of Spikelets.

wing which terminates in a free falcate appendage slightly above the middle of the glume; margins of the glumes not hyaline. Sterile lemmas minute, scale-like, glabrous, equal in size and closely appressed to the base of the lemma. Fertile lemma smooth, almost glabrous, shining, ovate-elliptical in outline.

Mediterranean Region and the Orient.

The species is naturalised in Western Australia in the metropolitan area, but is not yet common. It is distinct from the other species enumerated by reason of its sterile spikelets which appear to fall off entire with the fertile floret, and in the straight hard glumes. It is an annual of no known economic importance.

HYBRIDISM.

There appears to be some evidence that hybridisation occurs under conditions of cultivation between *Phalaris minor* and *P. tuberosa.* Few, if any, of the commercial samples of seeds of "Toowoomba Canary Grass" are pure *P. tuberosa,* and the majority would seem to be closer to what Hackel called *P. stenoptera.* Assuming (as we must) that *Phalaris tuberosa* has the two sterile lemmas developed and that *P. minor* has only the upper sterile lemma developed, then some, or the majority of the commercial seed resembles that of *P. minor* with a narrower floret, and the plants are perennial in habit. We notice that the strains of Toowoomba Canary Grass under cultivation locally vary considerably in the production of the internodal swellings which are a feature of *P. tuberosa.* In other words, much of the Toowoomba Canary Grass is identical with Hackel's *Phalaris stenoptera,* but rather than regard this as a valid species it is better to regard *P. stenoptera* as typical of the *P. tuberosa-P. minor* hybrid, and not as a synonym for *P. tuberosa,* Linn.

In dealing with this hybrid form which occurs so freely in commercial samples of "P. tuberosa" seed, the character of the lower sterile lemma is of no importance, and the only reliable test between such seed and that of *P. minor* is the germination test referred to below.

The above condition would account for the statement of Ewart in the "Flora of Victoria," p. 135, "Apparently pure seed (of *P. stenoptera*) often appears to produce seedlings of *P. minor* and *P. bulbosa.*"

COMMERCIAL SEEDS.

Some difficulty has been experienced in obtaining indubitable seed of "*Phalaris tuberosa*" of reasonable purity, this being usually adulterated with seeds of *P. minor,* an annual species which it is undesirable to incorporate in perennial pastures. The difference in price between the seeds of the two species also makes such adulteration undesirable. The seeds of both species vary in colour from a pale to a dark brown, but usually may be separated on their shape and the form of the sterile florets. In the case of machine dressed seeds the sterile florets are usually damaged, thus making the shape the main superficial feature for distinguishing them. The seed of "*P. tuberosa*" has an average length and breadth of 3.25mm. and 1.25mm. respectively and is rather narrow-ovate-elliptical gradually tapering to a point. In comparison, the seed of *P. minor* is broadly ovate-elliptical, rather more abruptly narrowed to a point, with an average length of 2.75mm. and breadth of 1.25mm.

A certain amount of variation in shape occurs, and difficulty is sometimes experienced in distinguishing between narrow seeds of *P. minor* and small seeds of "*P. tuberosa,*" particularly after machine dressing has damaged the sterile florets. In such cases where determination by means of external characters is unsuccessful, the seeds of the two species may be separated by means of a germination test carried out on damp blotting paper. The roots, and more particularly the root caps of *P. minor* seedlings show a reddish colour, while those of "*P. tuberosa*" are a greenish-white. By a simple count with a given number (say 100) seeds the approximate percentage of "*P. tuberosa*" may be estimated.

It is evident that samples of "*P. tuberosa*," containing impurities of the annual species, or even consisting entirely of them as sometimes is the case, have had a considerable effect in retarding the development of Toowoomba Canary Grass. Farmers buying the seed as a perennial species, and finding that the plants die out during the first season (due to such impurities) naturally consider the Toowoomba Canary Grass unsuitable for their district. To quote an example: an introduced line of seeds from overseas received as *P. tuberosa* was planted in the local experimental plot. Upon flowering it was determined as *P. minor* and died out towards the end of November. Although a good sample of the annual species, this seed would have been useless—in fact detrimental—in a permanent pasture seed mixture for which purpose the bulk was probably used.

"*Phalaris tuberosa*" is not a heavy seed producer, and this, together with the considerable demand made on the comparatively few producers, has made the seed expensive. By careful collecting in a reasonably pure crop, seeds of 95 per cent. purity can be obtained. Usually the germination is comparatively low, probably due to irregular ripening of the seeds within the heads, so that a sample giving a germination of 60 per cent. must be considered quite good. As with most other commercial seeds, even if the above conditions are fulfilled, care should be taken to select a reliable strain, since even within the species there is a variation in leaf production, permanence and other features affecting the value of the grass. This difficulty is best overcome by buying from a reliable seedsman or producer. A system of Government certification of "*P. tuberosa*" seed would simplify the buying of seed, and generally assist the establishment of this grass.

Little seed of *P. minor* and *P. canariensis* is sold for agricultural purposes, and as yet the other species mentioned in this paper are in their early experimental stages locally.

EXPLANATION OF PLATES

PLATE I

A.—G. Diagrams of panicles (reduced in size).

A. *Phalaris canariensis*, Linn. B. *P. minor*, Retz. C. *P. tuberosa*, Linn. D. *P. caerulescens*, Desf. E. *P. angusta*, Nees. F. *P. arundinacea*, Linn. G. *P. paradoxa*, Linn. H. Diagram illustrating the growth of *P. tuberosa*, showing the internodial swellings, the "tubers." J. Diagram of the ligule of *Phalaris*.

K.—Q. Drawings of fruits (magnified eight times).

K. *P. canariensis*. L. *P. minor*. M. *P. tuberosa*. N. *P. caerulescens*. O. *P. paradoxa*. P. *P. angusta*. Q. *P. arundinacea*.

PLATE II

Spikelets and fruits ("seeds").

(The numbers following the letters refer to florets.)

A. *P. canariensis*, Linn. Haywood, Staffordshire, England. P. P. Thornton, Aug. 1924.

B. *P. minor*, Retz. Merredin, W.A. W. M. Carne, 1924.

C. *P. tuberosa*, Linn. Earnsileugh, Otago, New Zealand, H. H. Allen.

D. *P. caerulescens*, Desf. S. Juan de Alcaras, Spain. E. Bourgeau, July, 1850.

E. *P. angusta*, Nees. Bassendean, W.A. C. B. Palmer, Nov., 1929. (E2 is again enlarged from E1.)

F. *P. arundinacea*, Linn. Glumes from Hitchcock's Text Book of Grasses; fruit from "Canary Grasses of New Zealand," Allen & Zotov.

G. *P. paradoxa*, Linn. Bassendean, W.A. C. B. Palmer, Oct., 1928.

The fruit of Phalaris arundinacea in Plate I. is drawn from seed received from the Waite Research Institute, South Australia.

The fruits and glumes of *P. tuberosa* are drawn from New Zealand specimens, and although apparently typical, may not be true *P. tuberosa*.

Icon. origin.

BROWN ROT OF CITRUS.

A SERIOUS DISEASE THAT CAN BE EASILY PREVENTED.

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

There are two forms of "Brown Rot" present in this State on *Citrus spp.* (1, 2, 3),* one of which, due to the fungus *Phytophthora hibernalis,* Carne, occurs mainly during the cold wet weather of the winter; while the other, caused by *Phytophthora (Pythiacystis) citrophthora* (Smith and Smith), Leonian, causes losses during the warm moist weather of the late autumn or spring. While at one time the cold weather disease apparently dominated the situation in this State and the warm weather organism was little, if at all, heard of (1, 2, 3),* the warm weather disease, known for sake of clarity as the "Californian" Brown Rot, has become of very considerable importance, especially on lemons, during the past two years.

During October, 1930, almost complete defoliation of lemon trees was caused by *Phytophthora citrophthora* in a number of localities on the Coastal Plain and in the Darling Range. Unwarned by this occurrence, many neighbouring orchardists lost almost their complete crop of lemon fruits and leaves in the spring of 1931 on account of the ravages of the "Californian" disease. When asked why they had not sprayed their trees in the autumn as a routine precautionary measure against "Brown Rot," many replied that they had come to regard the "usual" form of "Brown Rot" as of little consequence in ordinary years, provided the lower branches were kept well pruned up off the ground. A little fruit would always be spoiled and more or less foliage lost, but "nothing to worry about."

Such an attitude is incomprehensible to the writer, who regards preventive spraying of citrus trees in this State as just as much a routine part of the process of growing them as manuring or cultivation.

SYMPTOMS OF THE DISEASE—GENERAL CONSIDERATIONS.

The "Californian" Brown Rot as it occurs in this State agrees with American experience in that it is essentially a disease of lemon leaves and fruit. Orange and mandarin trees growing amongst almost entirely defoliated and defruited lemon trees are usually comparatively little affected. On the other hand the "Australian" form attacks oranges and mandarins more frequently than lemons. Other varieties of citrus than those already mentioned are only grown to a very small extent in this State, and no observations have been made concerning their susceptibility to attack by either parasite.

Both forms occur very much more seriously on very heavy clay soil with a high moisture content than on lighter and better drained soils. Lemon trees growing on very sandy soil frequently show hardly any trace of Brown Rot, whereas similar trees on heavy soil a short distance away on the same orchard may, at the same period, be almost completely defoliated and have most of the fruit affected.

The symptoms shown by affected fruits and leaves are very much the same on matter by which of the parasites the disease is caused.

FRUIT SYMPTOMS.

Affected orange and mandarin fruits develop a dull brown area, usually on one side, which spreads outwards from the original point of infection in a more or less circular fashion until the whole fruit may be involved. The affected areas

* See references to literature cited at end of article.

remain firm to the touch unless secondary organisms have gained entry. Orange, lemon, and mandarin fruits affected with brown rot are accompanied by a very penetrating and characteristic odour, quite distinct from the odours produced in rotting citrus fruits by such organisms as "Blue Mould," *Penicillium spp.*, or the "Sour Rot" fungus, *Oospora citri-aurantii.*

If free from secondary organisms, the affected areas become dark brown, dry, and eventually sunken; the whole fruit finally shrinking to a hard, dry mummy. This, of course, usually only occurs when the fruits are kept in a dry place. In the orchard, however, where the infected fruits are frequently moistened by rain or dew, secondary organisms almost invariably invade the "Brown Rotted" fruits and prevent mummification.

During wet conditions in the orchard, or when placed in a moist jar, a whitish growth of fungal threads (*mycelium*) develops on and around the lesions. Where fruits are borne in bunches and one or more is obviously affected with "Brown Rot," the apparently sound fruits growing in contact with the diseased are generally also infected. The first-infected fruits and leaves are generally those in contact with, or close to the soil, but later on infected fruits and leaves may be found at any position in the tree, due to the flicking of *spores* (fungus-seeds) in drops of moisture by the movement of the branches to higher parts of the same or neighbouring trees. In general, however, the disease is progressively less abundant towards the top of the tree.

Affected lemon fruits develop a washed-out, tightly-drawn, pale yellow or almost white colour on the diseased areas, showing in marked contrast to the brighter yellow of the sound skin. A pink or reddish stain may mark the point of infection in the case of the "Californian" form, but has not been observed with the "Australian" disease. The affected areas eventually turn brown. In the rare absence of secondary infection, diseased fruits shrink and dry.

LEAF SYMPTOMS.

Affected leaves of lemons, oranges, and mandarins develop dark-coloured, water-soaked areas, usually at the tips, but sometimes at the edges, or occasionally located in the middle of a leaf. Diseased leaves curl up towards the tips and characteristically fall very readily while still green and healthy-looking over the greater part of their surfaces. The falling of the leaves is one of the most obvious signs of the presence of the disease in the early stages. Affected leaves which remain attached to the tree eventually become brown in colour over the affected areas.

Leaf and fruit infections tend to be more common on the sides of the trees sheltered to some extent from the sun and wind, *i.e.*, on those parts of the tree which remain moist longest after rain. In densely foliaged trees the disease sometimes works in a funnel-like manner from the bottom to the top of the tree, leaving an outer zone of leaves and fruit unaffected.

CONTROL.

1. The winter form of Brown Rot can be very readily prevented in this State by spraying the lower two-thirds of the tree in the autumn, say at the middle to the end of April, before the autumn rains commence, with home-made Bordeaux mixture, 5-5-50, or, if preferred, with commercial ready-mixed so-called "Bordeaux" powders, at the rate of one pound to five gallons of water.* To ensure the

* True "Bordeaux" mixtures are those in which the bluestone is neutralized with lime; those in which the neutralizing is done with soda should more properly be known as "Burgundy" mixtures. Generally speaking, these latter are more caustic than the former.

maximum possible protection, ½ lb. of calcium caseinate spreader should be added to each 50 gallons of spray. In mixing the spreader, make the required amount of calcium caseinate into a paste in a billycan, jug, or other suitable receptacle by putting the caseinate into the dry container and then adding as much water by volume as there is caseinate. Stir, so as to form a thin paste (just in the same way as powdered skim milk is mixed by the experienced housewife for human use) and, when made into a paste, dilute with water and add to the mixture in the spray tank, keeping the agitator going during the process.

The trunks of the trees should be well drenched with the spray as a precautionary measure against "Brown Rot gummosis," which has been found on the trunks of citrus trees, especially lemons, in several orchards in this State on very heavy moist soils.

2. To guard against further infection in the spring by the "Californian" organism, spray the lower two-thirds of the trees with Bordeaux 5-5-50 in late winter or very early spring, say in the first or second week of August.

If more than the lower two-thirds of each tree is sprayed, a serious increase in the number of scale insects is likely to occur, owing to the killing off, by the Bordeaux mixture, of the beneficial fungi which parasitise the scale insects and help to keep them in check.

When spraying the trees, the soil below, and also in between the trees, should be sprayed with the Bordeaux, as infection carries over from one year to another in diseased tissues in the soil. Moreover, quite apart from its fungicidal value, Bordeaux mixture has a tonic effect on the growth of citrus trees; crushed bluestone up to 2 or 3 pounds weight per tree being applied annually to the soil in certain cases to prevent or cure the physiological die-back and gumming disease known as "Exanthema." (See Department of Agriculture Leaflet 176, 2nd edition.)

If spraying is delayed until the disease is already well established, the disease will continue to show up on a further lot of leaves and fruit for about ten days or a fortnight after spraying, as the spraying is a preventive, not a cure; so that any infection which has taken place just prior to spraying must run its course, quite irrespective of the fact that a deposit of poisonous material is covering the outside of the recently-invaded tissues.

Leaflet No. 314, which gives simple directions for the preparation of Bordeaux mixture in either small or large quantities, is obtainable, free of charge, upon application to the Department of Agriculture. A full account of the preparation of this excellent fungicide can also be found on pages 600-609 of the December, 1930, issue of the "Agricultural Journal." Growers are especially advised to make use of stock solutions of bluestone and of lime, as therein advised, to simplify the process of making the Bordeaux. The directions should be followed very closely, and growers should be particularly careful only to use the very best freshly-burnt or "quick" lime. Air-slaked lime is useless for the preparation of Bordeaux mixture. A rough but useful test which should always be made after the Bordeaux mixture has been prepared, and before spraying the plants with it, is to dip the clean blade of a penknife or a bright piece of iron, such as a shiny nail, into the mixture for several minutes. If the mixture does not contain enough lime, a reddish-brown deposit of copper will form on the iron and more lime will need to be added, until, on further testing with a fresh knife blade or shiny nail, no stain is obtained. If this test is always carried out before spraying with the Bordeaux mixture, there need be no fear of burning citrus plants with the spray.

3. In addition to spraying in the autumn and early spring with Bordeaux mixture, the control of this disease will be facilitated if any excess branches are thinned out so as to allow plenty of light and air into the centre of the tree to dry up the moisture as rapidly as possible after rain or dew, etc.

4. Any very low-hanging branches which tend to drag on the ground in the wind or when weighed down by fruit or by rain should be pruned back so as to leave at least a foot of clear space above the ground all round the tree. This will allow greater freedom of air and light movement and will facilitate the drying of the leaves and fruit after rain or dews, etc. *Phytophthora spp.* are water-loving organisms, and it is only in the presence of abundance of moisture that they can infect the plant tissues.

5. For the reason just indicated, the drainage, if defective, should be improved.

6. Should the spraying not have been done early enough to prevent the disease establishing itself, spraying should be carried out at the earliest opportunity, *i.e.*, during the earliest fine bright weather.

7. All diseased fruits should be gathered up and destroyed by boiling or burying in a deep hole well away from the site of the orchard, and where there will be no danger of flood waters unearthing them and spreading them around the countryside.

LITERATURE CITED.

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CLOVER SPRINGTAIL (LUCERNE FLEA) (Smynthuris viridis) INVESTIGATION.

By

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and

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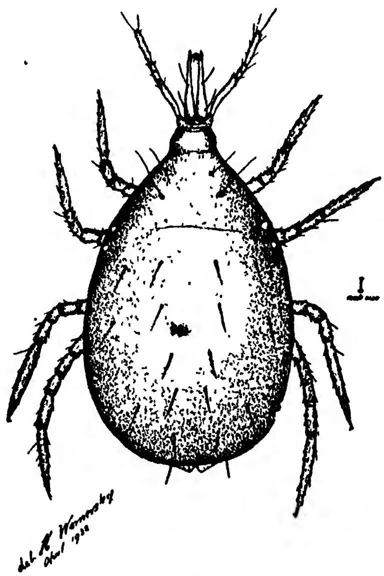
One of the results of this investigation has led to the discovery of a predatory mite which gives promise of considerable natural control of the Clover Springtail.

This predator is one of the Snout Mites (*Bdillidae*), in particular a species known as *Biscirus lapidarius* (Kramer). This discovery was made as a result of considerable research in the field in various parts of the flea-infested areas.

This predator is now known to occur at Waroona, Burekup, and Denmark. In each of these places there is considerable evidence of its utility as a controlling factor.

With the object of further assisting this work, the co-operation of all farmers is desired on the following lines: Wherever the flea was at one time prevalent and is now known to be definitely on the decrease, search should be made for this predator, and at the same time this information forwarded to this Department. If such conditions are found, it is inadvisable to adopt any artificial treatment owing to the risk of destroying the beneficial creature. Before such determination is arrived at, however, examples of the supposed predator should be submitted to the Department of Agriculture for definite determination.



Biscirus lapidarius (Kramer).

One of the Snout-mites (*Bdellidae*), predatory on the Clover Springtail (*Sminthurus viridis*).

Description.

This predator is a small light reddish to dark red mite, which runs about actively in close proximity to the surface of the ground amongst the clovers and other pasture plants. It can be recognised by the presence of a long snout (see illustration), eight legs, and two long feelers (palps).

It has a habit of hiding, particularly during warm, dry spells, under pieces of bark, slats of wood, or other suitable cover. When the identity of the mite is definitely established, it can be distributed to other parts of the infested area by transferring the slabs of wood or other shelter to which it is clinging. By taking this action, the beneficial mite can be greatly assisted in its welcome spread.

FERTILISERS.

N. DAVENPORT, Inspector of Fertilisers.

The Fertilisers Act, 1928, provides that a list of the fertilisers registered for each current fertiliser year may be published, and the appended table shows all registrations up to 31st May of this year.

The unit values computed from the prices of these fertilisers are listed below, as are also those for 1931 for comparison.

The greatest reduction in unit values is that for nitrogen in organic fertilisers such as bonedust, blood and bone, etc. In this case a fall of from 32s. to 24s. per unit has occurred, equal to 25 per cent.

There is little variation shown in the prices of water, citrate and acid soluble phosphoric acid units, the only revision being the raising of the water and citrate soluble forms by 1d. per unit.

The price of nitrogen, as sulphate of ammonia, has dropped 2d. per unit to 12s. 6d., but there is still a considerable difference from the English price of 5s. 4d. per unit.

There has been a marked increase of both forms of potash, viz., sulphate and muriate, principally due to varying exchange rates between the Continent and London and Australia, combined with depreciation of sterling and increased production costs.

UNIT VALUES.

	1931.			1932.	
	s.	d.		s.	d.
NITROGEN (N).					
As blood and bone, bonedust, and bone and flesh ...	32	0	...	24	0
,, nitrate	20	0	.	20	3
,, ammonia	12	8	...	12	6
PHOSPHORIC ACID (P_2O_5).					
As water soluble	4	1	...	4	2
,, citrate soluble	4	1	..	4	2
,, acid soluble :—					
in bonedust	...		..	6	6
in blood and bone and other animal fertilisers	6	6	...	5	6
in basic phosphate	...		...	5	6
in superphosphate and rock phosphate ...	2	6	...	2	6
POTASH (K_2O.)					
As sulphate	6	0	...	7	4
,, muriate	4	11	...	5	6

FERTILISERS.

The following fertilisers have been registered at the Department of Agriculture, under the Fertilisers Act, for the year commenced 1st November, 1931:—

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients. Nitrogen (N) as Nitrate.	Nitrogen (N) as Ammonia.	Nitrogen (N) as Blood and Bone.	Nitrogen (N) as Bone.	Phosphoric Acid (P_2O_5) as Water sol.	Phosphoric Acid (P_2O_5) as Citrate sol.	Phosphoric Acid (P_2O_5) as Acid sol.	Phosphoric Acid (P_2O_5) as Total.	Potash (K_2O) Sulphate.	Potash (K_2O) Muriate.	Price per ton on rails at works or Perth
A.—MINERAL.													
1. NITROGENOUS:			%	%	%	%	%	%	%	%	%	%	£ s. d.
(a) Nitrogen as Nitrate:													
Nitrate of Soda	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	15·5										15 4 0
Do.	do. do.	ML (in diamond)	15 5										15 4 0
Do.	do. do.	CSML	15·5										15 4 0
Do.	Cresco Fert. (W.A.), Ltd.	Cresco	15 0										16 10 0
Nitrate of Lime	do. do.	do.	15·5										16 0 0
(b) Nitrogen as Ammonia:													
Sulp. Ammonia	Cuming Smith, Mt. Lyell	Sickle		20 5									12 15 0
Do.	do. do.	ML (in diamond)		20 5									12 15 0
Do.	do. do.	CSML		20 5									12 15 0
Do.	Cresco Fert. (W.A.), Ltd.	Cresco		20·0									12 15 0
Do.	F. Viles	ICI (in circle)		20·6									12 15 0
2. PHOSPHATIC:													
(a) Rock Phosphates:													
Pacific Islands Phosphate	Cuming Smith, Mt. Lyell	Sickle							36 65	36 65			4 11 6
Do.	do. do.	ML (in diamond)							36·65	36 65			4 11 6
Do.	do do	CSML							36 65	36·65			4 11 6
Phosphate Powder	Cresco Fert. (W.A.), Ltd.	Cresco							34 80	34 80			4 10 0
(b) Superphosphates:													
Florida Super, 22 per cent.	Cuming Smith, Mt. Lyell	Sickle					20 5	·5	1 0	22·0			4 10 0
Mt. Lyell Super. 22 per cent.	do. do.	ML (in diamond)					20·5	·5	1 0	22·0			4 10 0
Superphosphate, 22 per cent.	do. do.	CSML					20 5	·5	1 0	22·0			4 10 0
22 Super.	Cresco Fert. (W.A.), Ltd.	Cresco					20·5	·5	1 0	22 0			4 15 0
Florida Super., 24 per cent.	Cuming Smith, Mt. Lyell	Sickle					22 0	·5	1 5	24 0			4 15 0
Mt. Lyell Super., 24 per cent.	do. do.	ML (in diamond)					22 0	·5	1·5	24 0			4 15 0
Superphosphate, 24 per cent.	do. do.	CSML					22·0	·5	1 5	24·0			4 15 0
24 Super.	Cresco Fert. (W.A.), Ltd.	Cresco					22·0	·5	1·5	24·0			5 0 0
46 Super.	do. do.	do.					46·0		...	46 0			11 5 0
(c) Rock Phosphates and Superphosphates:													
Phosphate Mixture, 50/50	Cuming Smith, Mt. Lyell	Sickle				...	10·0	1·0	18·0	29·0	...	...	4 11 6

Do.	do. do	ML (in diamond)				10·0	1·0	18 0	29·0	...	...	4 11 6
Do.	do. do	CSML				10 0	1·0	18·0	29·0	...	..	4 11 6
50/50 Phosphate	Cresco Fert. (W.A.) Ltd	Cresco				9·16	1·84	17 40	28 40	...	.	5 0 0
(d) Basic Phosphates:												
Basic Phosphate ...	Cuming Smith. Mt. Lyell	Sickle				.	...	17 0	17·0	..	.	4 14 0
Do. ...	do. do.	ML (in diamond)				...	...	17·0	17·0	...	..	4 14 0
Do. ...	do. do.	CSML				...	..	17 0	17·0	...		4 14 0
3.—POTASSIC:												
(a) Potash as Sulphate:												
Sulphate of Potash ..	do do.	Sickle ...				...		.	...	48·6	.	17 11 6
Do. ...	do. do	ML (in diamond)				..		...	...	48·6	..	17 11 6
Do. ...	do. do	CSML				..		.	...	48·6	.	17 11 6
Do ...	Cresco Fert. (W.A.), Ltd	Cresco ...				..	.	..	...	48·5		18 0 0
Do.	Pacific Potash, Ltd	Sun (and diagram)				.		.	...	48·6	.	18 0 0
(b) Potash as Muriate:												
Muriate of Potash	Cuming Smith, Mt Lyell	Sickle ..				..			...	..	50·0	14 1 6
Do. ..	do do	ML (in diamond)				..			...	..	50·0	14 1 6
Do. ..	do do	CSML				.		.	.	.	50·0	14 1 6
Do	Cresco Fert. (W.A.), Ltd	Cresco				..		.	...	...	50·0	14 10 0
Do	Pacific Potash, Ltd	Sun (with diagram)				.	.		.	..	50 0	14 10 0
Kainit ...	do do	do				.			.	...	14 0	*
Potash Manure Salts ...	do do	do ..				.		..	..	.	30·0	8 10 0
30 per cent Potash salts	Cresco Fert (W.A.) Ltd	Cresco				..		.	..	..	30·0	8 10 0
4.—NITROGEN AND PHOSPHORIC ACID:												
Ammonia and Phosphate	Cresco Fert (W.A.), Ltd	do		2 0		8 3	1 6	15 7	25·6			6 5 0
Ammonia and Phosphate. No. 2	do do	do		3 5		15 0	4	1 6	17 0	.	.	7 2 6
Super and Ammonia ...	do do	do		5 0		15 37	...	1 13	16 5			7 2 6
Super and Ammon. No. 1	Cuming Smith Mt Lyell	Sickle		1 5		16·0	4	2 1	18·5	.		5 9 0
Do. ... No 1	do do	ML (in diamond)		1 5		16 0	4	2 1	18·5	.		5 9 0
Do. No 1	do do	CSML		1 5		16 0	4	2 1	18·5	.		5 9 0
Do. No 2	do do	Sickle		3 5		15 0	4	1 6	17·0			6 14 0
Do. No. 2	do do	ML (in diamond)		3 5		15 0	4	1 6	17 0	.	.	6 14 0
Do No 2	do do.	CSML		3 5		15 0	4	1 6	17·0		.	6 14 0
Do No. 3	do do.	Sickle		6 0		13·5	4	1·6	15·5	..		7 14 0
Do. .. No 3	do. do.	ML (in diamond)		6 0		13 5	4	1 6	15 5	.		7 14 0
Do. No. 3	do do.	CSML		6 0		13·5	4	1 6	15 5			7 14 0
No. 2, Potato	do do	ML (in diamond)		3 5		15 0	·4	1 6	17 0			6 14 0
Special Potato Manure C	do. do	Sickle		3 5		15·0	4	1 6	17 0	.		6 14 0
Do. do	do do	CSML		3·5		15 0	4	1 6	17·0			6 14 0
No. 6, Potato ...	do do	ML (in diamond)		6·0		13 5	4	1·6	15 5	.	.	7 14 0
Special Potato Manure F	do. do.	Sickle ...		6·0		13 5	4	1 6	15 5		.	7 14 0
Do. do	do. do	CSML		6·0		13·5	·4	1 6	15 5			7 14 0
Potato Fertiliser X	Binney & Son	Swan		3 2		10 25	..	1 09	11·34			7 7 6
Do. do	D F Carbarns & Co	Crown		3·2		10·25	..	1 09	11 34	.		7 7 6
Potato Fertiliser C ..	A Richards	Vigor		3 2		10 25	.	1 09	11 34			7 7 6

FERTILISERS—*continued.*

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients. Nitrogen (N) as Nitrate.	Nitrogen (N) as Ammonia.	Nitrogen (N) as Blood and Bone.	Nitrogen (N) as Bone.	Phosphoric Acid (P_2O_5) as Water sol.	Phosphoric Acid (P_2O_5) as Citrate sol.	Phosphoric Acid (P_2O_5) as Acid sol.	Phosphoric Acid (P_2O_5) as Total.	Potash (K_2O) as Sulphate.	Potash (K_2O) as Muriate.	Price per ton on rails at works or Perth.
			%	%	%	%	%	%	%	%	%	%	£ s. d.
5.—NITROGEN, PHOSPHORIC ACID AND POTASH:													
No. 3 Potato	Cuming Smith, Mt. Lyell	ML (in diamond)		3·75			14 50	·35	·75	15·6	4·5	...	7 19 0
Special Potato Manure B	do. do.	Sickle		3 75			14 50	·35	·75	15·6	4·5	...	7 19 0
Do. do.	do. do.	CSML .		3 75			14·50	·35	·75	15·6	4 5	...	7 19 0
No. 4, Potato	do. do.	ML (in diamond)		3·5			14·0	·3	7	15·0	8 0	..	8 16 6
Special Potato Manure E	do. do.	Sickle		3·5			14·0	·3	·7	15·0	8·0	...	8 16 6
Do. do.	do. do.	CSML		3·5			14·0	·3	7	15·0	8·0	...	8 16 6
No. 7, Potato	do. do.	ML (in diamond)		3·5			10·5	2	·6	11·3	16 0	...	10 6 6
Special Potato Manure G	do. do.	Sickle		3·5			10·5	2	·6	11·3	16·0	...	10 6 6
Do. do.	do. do.	CSML ...		3·5			10·5	·2	·6	11·3	16·0	...	10 6 6
No. 8, Potato	do. do.	ML (in diamond)		4 0			12 7	·3	7	13·7	9 0	...	9 1 6
Special Potato Manure H	do. do.	Sickle		4·0			12·7	3	·7	13·7	9·0	...	9 1 6
Do. do.	do. do.	CSML		4·0			12 7	·3	·7	13·7	9·0	...	9 1 6
Special Potato Fertiliser	do. do.	Sickle ...		7·5			7·0	·2	4	7·6	13·25	...	11 9 0
Do. do.	do. do.	ML (in diamond)		7·5			7·0	·2	4	7 6	13·25	...	11 9 0
Do. do.	do. do.	CSML ...		7·5			7 0	2	·4	7·6	13·25	...	11 9 0
Potato Special	Cresco Fert. (W.A.). Ltd.	Cresco		4 0			12 5	5	·75	13 75	8·75	...	9 15 0
Potato Manure	do. do.	do.		1·5			7 1	1 4	13 5	22·0	7·5	...	7 12 6
Potato Manure No. 2 ...	do. do.	do.		8 2			8 2	...	..	8·2	. .	10·0	11 0 0
Mixed Manure	do. do.	do.		1·5			7 1	1 4	13·5	22·0	7·5	...	7 12 6
Mixed Manure, No. 2 ...	do. do.	do ..		2 0			16 5	...	1·0	17·5	5·0	...	7 12 6
Do. No. 3 ...	do. do.	do.		3·0			14·0	. .	...	14·0	6·0	...	8 15 0
Potato Fertiliser ...	Binney & Son	Swan		3 2			10 25	. .	2 0	12 25	4 0	...	8 12 6
Do.	D. F. Carbarns & Co. ..	Crown .		3 2			10 25	.	2 0	12 25	4·0	...	8 12 6
Special Mixture K ...	Cuming Smith, Mt. Lyell	Sickle .. .		8·34			8 4	·2	·4	9·0	...	10·04	10 6 6
Do. K ..	do. do.	ML (in diamond)		8·34			8·4	2	·4	9·0	...	10·04	10 6 6
Do. K ...	do. do.	CSML .. .		8 34			8·4	2	·4	9·0	...	10·04	10 6 6
Orchard Manure ...	do. do.	Sickle ..		2·0			14·0	·4	1 6	16·0	...	5·0	6 19 0
Do.	do. do.	ML (in diamond)		2 0			14·0	·4	1·6	16·0	...	5·0	6 19 0
Do.	do. do.	CSML		2 0			14·0	4	1·6	16·0	...	5·0	6 19 0
Do.	Cresco Fert. (W.A.). Ltd.	Cresco ..		1·5			7·1	1·4	13 5	22·0	7·5	...	7 12 6
Tobacco Manure ...	do. do.	do. ...		3·3†			14·2	.	1·3	15·5	5 6	...	8 7 6
Tobacco Fertiliser ...	Cuming Smith, Mt. Lyell	Sickle .. .		3·3†			14 0	·5	1·0	15·5	5·7	..	8 2 6
Do. do.	do. do.	ML (in diamond)		3 3†			14·0	·5	1·0	15·5	5·7	...	8 2 6
Do. do.	do. do.	CSML		3·3†			14 0	5	1·0	15·5	5·7	...	8 2 6
Vine Manure	Cresco Fert. (W.A.). Ltd.	Cresco .		1 5			7·1	1·4	13·5	22·0	7·5	...	7 12 6
Rose Food	Sunnyside Products .	Sunnyside .		3 5			7·3	..	2 3	9 6	6 8	...	‡
Orchard Fertiliser No. 1	Binney & Son . .	Swan .		8·25			8·05	61	...	8·66	...	10·0	12 2 6
Do. ... No. 3	do.	do.		2 0			..	..	16·0	16·0	..	5·0	7 7 6

6.—MISCELLANEOUS:													
Super and Manganese ...	Cresco Fert. (W.A.), Ltd.	Cresco					17·0	·5	1 0	18·5			7 15 0
Crushed Sulphur ...	Cuming Smith, Mt Lyell	Sickle											15 4 0
Do.	do. do	ML (in diamond)											15 4 0
Do.	do. do.	CSML											15 4 0
Sulphate of Iron ...	do. do.	Sickle ...											11 1 6
Do.	do. do.	ML (in diamond)											11 1 6
Do.	do. do.	CSML											1 1 6
Domestic Garden, No. 2	W. J. Mathews ..	Wonder-growth ...					16·5	·35	1 0	17·85	5 0		‡
B.—ORGANIC OR PARTLY ORGANIC.													
1.—ENTIRELY ORGANIC:													
(a) Bonedust and Meals:													
Standard Bonedust ...	Cresco Fert. (W.A.), Ltd.	Cresco				2 75			18 3	18 3			10 1 0
Pure bonedust	do. do.	do.				3 5			22·0	22·0			11 10 0
Bonedust	Cuming Smith, Mt Lyell	Sickle . .				3 5			22 0	22·0			10 1 6
Do.	do. do.	ML (in diamond)				3 5			22 0	22 0			10 1 6
Do.	do do	CSML .				3 5			22·0	22 0			10 1 6
Standard Bonedust ..	Binney & Son .	Swan .				2 75			18 3	18·3			10 0 0
Bonedust Special, No 1	do. . .	do.				3 5			22 0	22·0			11 10 0
Standard Bonedust ..	D F. Carbarns & Co .	Crown .				2 75			18 3	18 3			10 0 0
Bonedust Special, No. 1	do. do	do				3 5			22 0	22 0			11 10 0
Bonedust	Henry Wills & Co.	W (in diamond)				2 75		6 0	13 0	19 0			10 0 0
Do.	W.A. Meat Exports. Ltd.	Eclipse ..				3 5			22 0	22 0			10 0 0
Do.	J. Cherry	K B M . ..				3 0			18·0	18 0			7 0 0
Bone Fertiliser	do. .	K B.M . .				3 0			18·0	18 0			7 0 0
(b) Bone Fertilisers:													
Blood and Bone ..	W.A. Meat Exports, Ltd.	Eclipse			6 0				12 0	12 0			10 0 0
Do.	Cresco Fert (W.A.), Ltd.	Cresco			6 0				12 0	12 0			10 5 0
Do.	Cuming Smith, Mt Lyell	Sickle . ..			6 0				12·0	12 0			10 0 0
Do.	do. do.	ML (in diamond)			6 0				12 0	12·0			10 0 0
Do	do. do	CSML . ..			6·0				12 0	12 0			10 0 0
Do	Midland Junction Abattoirs	State Abattoirs .			6 0				9 0	9 0			10 0 0
Do. ...	A. H Hassell ..	Sun .			5 25			8 5	4 5	13 0			11 0 0
Do.	Haynes & Clements ..	A1			5 25			3 0	9 0	12 0			11 0 0
Do. .. .	Wyndham Meat Works	Wyndham Meat Works			5·75			6 0	7 0	13 0			9 10 0
Do. A .. .	Binney & Son .	Swan .. .			7·0				15 0	15 0			14 0 0
Do. B	do	do.			6 0				12 0	12 0			10 10 0
Do.	G W. Pennell .. .	A N.A Surprise			5·5			4 0	10 0	14·0			10 10 0
Do . .	J. Kitchen & Son .	Apollo			5·25			3 0	12 0	15 0			9 5 0
Do.	Dickson, Primer & Co	Apex .			7 0				10 0	10 0			10 5 0
Do. B ...	do do.	do ..			6 0				16 0	16·0			10 0 0
Do.	John Tyler .	JT (over No 10)			5 25				12 0	12 0			10 10 0
Do.	A. Richards . .	Vigor .			5 0				14 0	14 0			10 0 0
Do.	D. F. Carbarns	Crown . .			5·6				14 0	14 0			10 10 0
Globe Bone Manure ...	Binney & Son .	Swan . .			2 0				18 0	18 0			8 15 0
Fish Fertiliser	do.	do. . .			4 5				12·0	12 0			12 0 0
Garden Fertiliser, D ...	do. ...	do.			1 85				8 3	8·3			8 0 0

FERTILISERS—*continued.*

Name of Fertiliser.	Firm	Brand.	Fertilising Ingredients. Nitrogen (N) as: Ni-trate.	Amm-onia	Blood and Bone.	Bone.	Phosphoric Acid (P_2O_5) as: Water sol	Citrate sol.	Acid sol.	Total.	Potash (K_2O): Sul-phate.	Mur-iate.	Price per ton on rails at * works or Perth.
			%	%	%	%	%	%	%	%	%	%	£ s. d.
2.—PARTLY ORGANIC:													
(a) Nitrogen and Phosphoric Acid:													
Bone and Super ...	Cresco Fert. (W.A.), Ltd.	Cresco				2 0	9·5	3 9	3 0	16 4	.	.	7 17 6
Do.	Cuming Smith, Mt. Lyell	Sickle			.	2·0	13·0	8	4·7	18·5	...		7 4 0
Do.	do. do.	ML (in diamond)	.		...	2 0	13 0	8	4 7	18 5	.	..	7 4 0
Do.	do. do.	CSML ..		...	.	2·0	13 0	8	4·7	18 5	...	.	7 4 0
Do. No. 1	Binney & Son ..	Swan ..		..		1 37	.	.	17·65	17 65	...		6 10 0
Do. No. 2	do. ...	do. ..		.	..	75	..		11 89	11·89	..	.	4 10 0
Orchard Fertiliser ...	Paterson & Co.. Ltd. ..	Patco			5 0	..	.	.	12 0	12 0	..	...	10 10 0
Domestic Garden, No. 1	W. J. Mathews ..	Wonder-growth .		.	3 75		12 0	·3	3 2	15·5	..	...	‡
(b) Nitrogen, Phosphoric Acid and Potash:													
Bone Super Potassium	Binney & Son	Swan	..	.	.	1 0	..		14 0	14 0	...	1·0	5 10 0
Special Potato (Bone basis)	do. ..	do. ..		..	..	3 0	.	.	15 0	15 0	...	2·25	9 10 0
Orchard Fertiliser, No. 2	do.	do .		..	..	**3·17		..	10 0	10 0	...	5 0	12 0 0
Orchard Manure ...	J. Cherry	K.B.M.		..		3 0		..	16 0	16 0	4·0¶	...	7 0 0
Potato Manure	do.	K.B M. ..		...	..	3·0	..	.	16 0	16·0	4·0¶	..	7 0 0
Fertos Manure	L. C. Horley	Fertos ..		4·2	.	...	5·5	1·35	2·30	9 1	..	5·9	‡

* Price not available. † Nitrogen partly in Nitrate form as Sodium Nitrate ‡ Sold in small packets only. § Manganese as MnO, 5 75 per cent. ‖ On rails, Albany.
¶ Potash from Wood Ash ** Nitrogen partly as Ammonia.

THE PEA WEEVIL

(Bruchus pisorum, Linn).

By L. J. NEWMAN, F.E.S., Government Entomologist.

The Pea Weevil is found in many parts of the world, but until quite recently was not recorded in Western Australia. It is regarded as a native of Europe. The spread or distribution of this pest has undoubtedly been per medium of infested seed.

Just how and where it gained entrance to our State may never be determined, but the fact remains that it has become established in several areas in the South-West. Local infested seed has been obtained from several widely separated localities.

These notes have been prepared with the object of assisting growers in recognising the weevil when they see it, and advising what methods of prevention and control to apply.

It is not a true weevil in the entomological sense, but generally it is known as such, hence the common name, Pea Weevil.

The damage caused is, in the main, to field pea crops grown for storage and dry feed purposes. Peas grown for consumption in the green stage are not seriously injured. The tiny grubs may be present, but being so undeveloped they do not affect the food value of the peas.

This so-called weevil does not continue to breed in stored dry peas. The attack never begins in storage and stops with stored seed, with the emergence of the insects that came within the seed from the field. If the peas are free when gathered from the field, they will not be attacked by this weevil. The infestation only takes place in the field, when the peas are green and in the pod. It is essential to the full development of the larva in the pea for the seed to reach maturity.

Infested seed stored away permits of the life cycle of the insect being completed. Infested seed is rendered useless for sowing and for feeding purposes.

DESCRIPTION OF ADULT.

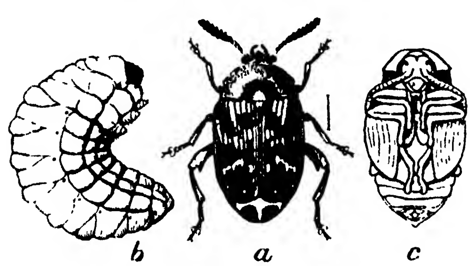


Fig. 1.—Pea Weevil: *a*, beetle; *b*, grub; *c*, pupa. True length of beetle shown by line at its right. (Chittenden U.S.D.A. *Yearbook*, 1898.)

General colour, from fawn brown to dark rusty brown, shading to black, with small patches of white hairs that form white spots upon the elytra or wing covers. There is also a distinct white patch at the basal centre of the thorax. The wing covers are shorter than the abdomen, leaving the pygidium or last dorsal segment exposed.

This segment is furnished with downy white hairs, with the exception of two black areas which, in contrast to the white, constitute conspicuous markings.

The legs and undersides of the body are dark reddish black. The antennae or feelers black, with the last four segments reddish yellow. The body length is between 3/16in. and 1/4in. The mature beetles are capable of flight. The adults make their appearance any time after December. Those that emerge and those that remain in the seed appear to aestivate during the dry summer months.

As the early winter comes in, some of the beetles become active. The bulk of them, however, do not issue forth until the early spring. It is certainly the spring outbreak that we have to fear, as it is this brood that attacks the young forming pea seeds.

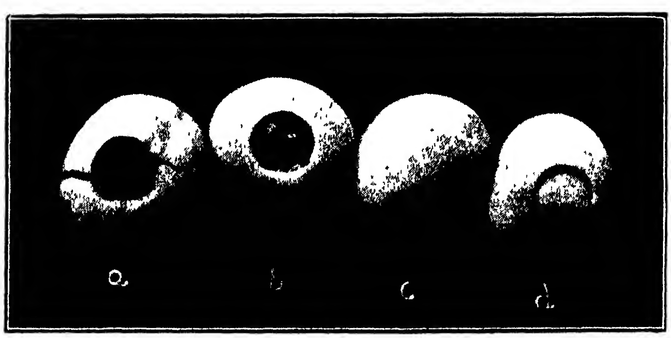
The beetles appear to feed upon any part of the plant, but do not cause serious damage. It is to the stored seed that the great economic loss occurs.

The Eggs.—These are oval, yellow bodies, glued to the exterior of the young pea pods. They are generally deposited singly, for the reason that there is only sufficient nourishment in a pea for one larva or grub. From 25 to 30 eggs are deposited by each female beetle.

The normal spring incubation period for the eggs is about 21 days.

The Larva.—The young grub, upon hatching from the egg, immediately burrows straight down into the pod. It possesses six short inconspicuous legs and powerful gnawing jaws. Having bored through the pod, it selects a young developing pea and cuts its way into it. Once ensconced within the pea, the larva or grub moults, when its legs are reduced to mere stumps. Here the grub spends the whole of its life, which occupies about three months, going through several moults, finally pupating and eventually cutting its way out an adult beetle.

The grub, before pupating, eats away the substance of the pea at one end, leaving only a thin circular semi-transparent cap, which is easily noticeable and is a typical indication of an infested seed.



A.—Showing exit hole of adult weevil B.—Adult weevil within pea ready to emerge. C & D.—Infested peas showing typical indication of the weevil within

Original—Andrewartha.

The Pupa.—This stage is also spent within the pea and lasts under normal weather conditions for three weeks.

PREVENTIVE AND CONTROL MEASURES.

Knowing that this pest is spread per medium of infested seed, keep a keen lookout. Any insects found in seed peas should be forwarded to the Entomological Office for identification. Never sow infested seed. If growing for seed, gather as soon as sufficiently ripe for stripping or thrashing. The longer the crop is left standing, the greater the damage.

When seed has been harvested, and weevil is suspected, treat with some approved fumigant. If this treatment is given as soon as the seed is gathered very little harm will have been done, as the larvae or grubs within the seeds have not reached their greatest damaging stage. If kept for a month the grubs will have greatly increased in size and eaten out large cavities in the peas. If kept for two months, without treatment, the grubs will have matured, resulting in only the outer shell of the pea being left. It is obvious that the seed must be treated as soon as gathered. The fumigant recommended is carbon-bisulphide.

The pea crop should be sown as early as possible, so that the crop can be harvested before the weevil has become seriously active. It is advisable to harvest the crop as much on the green side as is safe, rather than is usually done when the seed is left to get dead ripe. Pea hay or straw so cut contains a higher nutritive value; the seed is heavier and its germinating powers are not affected.

Rotation of crops is an important method of control. Each year the pea crop should be put in as far away from the previous year's crop as possible. This is necessary because many of the infested peas are shed to the ground before the crop is harvested.

A good purpose is served by allowing pigs or poultry to feed over a paddock which has previously carried an infested crop. They will clean up all the fallen peas. Infested land must be later thoroughly ploughed, seeing that the soil is well turned over.

All peas kept in storage should be bagged in sound bags, the tops being securely tied. If infested, the weevils will hatch out and die in the bags without further reproduction.

Hot Water Treatment.—Pea seed may be soaked for five minutes in a mixture of two parts of boiling water to one part of cold water, without being harmed, yet the grubs inside them will be destroyed. If not being sown then, they should be dried as rapidly as possible. The quantity of water used must be considerably in excess of the bulk of seed treated to allow for the take up and the complete covering. This is probably the most economical method the farmer can use for the treatment of small lots of seed.

Fumigation.—The most effective method is the exposure of the seed to the fumes of carbon-bisulphide. For the best results the seed should be treated as soon as possible after gathering.

For the purpose of applying this gas, it is essential to provide an air-tight room or receptacle. These should be tested and proved to be gas tight. The amount of the fumigant to be used is calculated upon the cubic feet of space to be fumigated. In the treatment of the pea weevil, it is essential to give a strong charge to ensure the gas penetrating the fine borings made by the grubs when entering the young developing peas.

Formula.—To every 1,000 cubic feet of space use 3 lbs. of carbon-bisulphide. The fumigant may be poured directly on to the seed or on to pieces of bagging or into shallow dishes. Being a heavier than air gas, it is always applied to the top of the produce being treated. The gas falls downwards and has a most penetrating power. The period of fumigation should not be less than 48 hours, and should not exceed 60 hours.

To find the cubic contents of a room or other receptacle having rectangular sides, multiply the length x breadth x height. Example:—A room 10ft. x 10ft. x 10ft. = 1,000 cubic feet of space.

A good sound barrel makes a good medium for the fumigation of small lots of seed. Take an ordinary 25 gallon barrel. This will accommodate a 200lb. bag

of seed. It should be made as airtight as possible by the application of two or three coats of paint and the stuffing up of any joints at the bottom. To a barrel of this size, use one fluid ounce (two tablespoonfuls). If any leakage is suspected, double the dose. The barrel should be covered with wet bags, weighted down.

If any other type of small container is used, calculate the amount of fumigant to be applied by the weight of seed to be fumigated.

Formula.—To every 200 lbs. of seed, use 1 fluid ounce of carbon-bisulphide.

Warning.—In using the carbon-bisulphide, all naked lights must be kept away, as it is explosive and inflammable. Do not enter any room so fumigated until it has been thoroughly ventilated and all traces of the gas have disappeared. With ordinary care and intelligent application, this fumigant is perfectly safe to use.

As this weevil has the potential possibilities of becoming a serious pest to field peas grown for storage and seed, every effort should be made to restrict its breeding.

Literature cited.—Pea and Bean Weevils.
S. H. Skaife, B.A., Assistant Entomologist,
Department of Agriculture, Pretoria, 1918.

SOLENOPOTES CAPILLATUS, ENDERLEIN, A SUCKING LOUSE OF CATTLE HITHERTO UNRECORDED FROM AUSTRALIA.

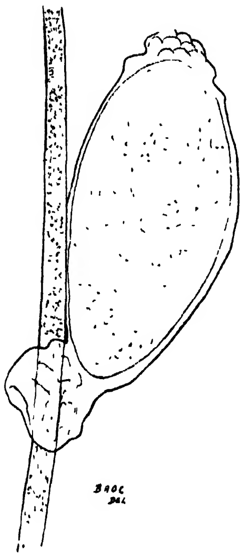
B. A. O'CONNOR, B.A., B.Sc.Ag., Agricultural Adviser.

On 16th March of the present year Mr. J. F. Filmer, B.V.Sc., Senior Veterinary Surgeon attached to the Departmental staff, brought in for identification some lice which he considered appeared unfamiliar. They had been found clustering on the neck and head of a heifer at Herne Hill, about 15 miles from Perth. On examination, the lice proved to be neither of the common sucking lice of cattle, *Linognathus vituli,* L. and *Haematopinus eurysternus,* Nitsch., but appeared to belong to the genus *Solenopotes.* Reference to Bishopp's paper on *Solenopotes capillatus,* End., established that the local specimens were of that species.

Slight variations from Bishopp's description occur in the chaetotaxy, but these do not appear to be of specific importance. The two small spines occurring on the dorsal surface of the head near the median line opposite the point of attachment of the antennae, were not found in the local specimens. The number of spines on the fifth abdominal tergite is given by Bishopp as 6 to 8, whereas in our specimens there are as many as 10. Also, on either side of the dorsum of the mesothorax, slightly inside and posterior to each mesothoracic spiracle, is a long spine, hair-like at the end, similar to those occurring on the terminal portion of the abdomen. Such a spine is not mentioned by Bishopp.

The occurrence of the lice on the neck and head of their host agrees with Bishopp's statement that "the species shows a marked tendency towards attacking in dense groups about the head and neck of the host."

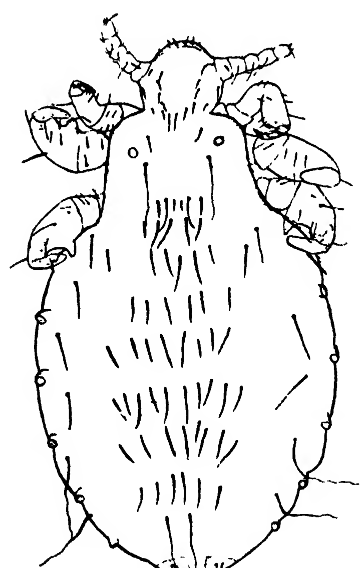
As far as the writer is aware, this species has not formerly been recorded from Australia, and no satisfactory explanation can be advanced to account for its



Egg of *Solenopotes capillatus* attached to hair of host. × 60.

Solenopotes capillatus: Ventral view of male. × 70.

Solenopotes capillatus: Ventral view of female. × 45.



Solenopotes capillatus: Dorsal view of female. × 45.

presence in this State. Enderlein described it from a male taken on cattle at Leipsig, Germany, in 1904. It was not known to occur in U.S.A. till 1917, when H. P. Wood identified specimens as belonging to this species. The earliest record from U.S.A. given in Bishopp's paper is 20th March, 1910.

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SILAGE COMPETITIONS, 1932.

WITH SOME NOTES ON MAKING SILAGE.

G. K. BARON-HAY, Superintendent of Dairying.

During the past season the interest shown by farmers in the production of silage has been most marked and has led to a considerable increase in the number of silos and stacks throughout the whole of the dairying districts. One of the ways in which this interest has been brought home to farmers is by the number of competitions held by various organisations in connection with the judging of the best exhibit of silage both at shows and in the field. These competitions have brought out very forcibly a number of factors which are essential for the production of good silage in an economical manner. The results of these competitions are given below, together with a few notes which will be of interest to those intending to make silage during the coming season.

HARVEY AGRICULTURAL SOCIETY—SILAGE COMPETITION.

The Field Committee of the Harvey Agricultural Society, which is a committee whose duty is to encourage and inquire into various methods of agriculture which would be of benefit to the district, recommended the carrying out of a Silage Competition for the first time last season. Only three entries were received, although a number of other stacks were built in the district, the owners of which did not consider them suitable for competition.

Judging was carried out late in February by Mr. C. Giles, Dairy Adviser, with the following results:—

Name.	Material and Mixture.	Type, Palatability and Value.	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
S. Fry, Benger ...	18	26	23	9	8	84
J. Smith, Wokalup ...	18	23	21	8	8	78
S. Bowers, Brunswick Junction	20	16	18	8	8	70

Mr. S. Fry, Benger.—A very good sample of grass silage; approximate tonnage of stack 45-50, of a light brown acid type; readily eaten by stock.

Mr. J. Smith, Wokalup.—Stack approximately 20 tons; acid type; brown in colour, showing less succulence than above; cut at later stage.

Mr. S. Bowers, Brunswick.—Approximate tonnage 20-25; dark sweet silage, excellent mixture (clover predominating), but ensiled at too high a temperature due to late cutting and slow handling.

The Judge, Mr. C. Giles, in his remarks stated that the waste in the stacks examined was excessively high, ranging from 20 to 30 per cent., which, however, could be avoided by earlier cutting and carting more rapidly from the field to the stack. The stack also should be opened from the top, the silage being removed in layers rather than from the side.

Several stacks in the district slipped over on the eastern side during the season. This was caused by the long bouts of hot easterly winds experienced, causing excessive drying and thus admittance of air into the windward side of the stack. It is suggested that where the stack is built in an exposed position, the windward side should be protected by bushes or bags.

BALINGUP AGRICULTURAL SOCIETY—SILAGE COMPETITION.

In order to encourage the building of a larger number of stacks for the conservation of fodder in this district, the above Society promoted a competition for the best silage stack.

Stacks were judged during the last week in March. Results of points allotted are as given in the following table:—

Name.	Material and Mixture.	Type, Palatability and Value	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
M. Dunstan	20	27	22	9	6	84
F. Holbrook	18	30	15	10	7	80
H. M. Moulden ...	15	27	16	9	9	76
G. E. White	20	27	15	7	5	74
W. Jenkins	15	23	12	7	6	63
W. Bailey	11	15	6	10	8	50

The following notes on the stacks examined were made by the Judge, Mr. M. Cullity, Agricultural Adviser:—

Mr. M. Dunstan.—Very good sample of subterranean clover and grass silage; slightly acid; of a good green colour, the clover being only slightly changed. Wastage was due to the uneven settling and to opening the stack by cutting into the side.

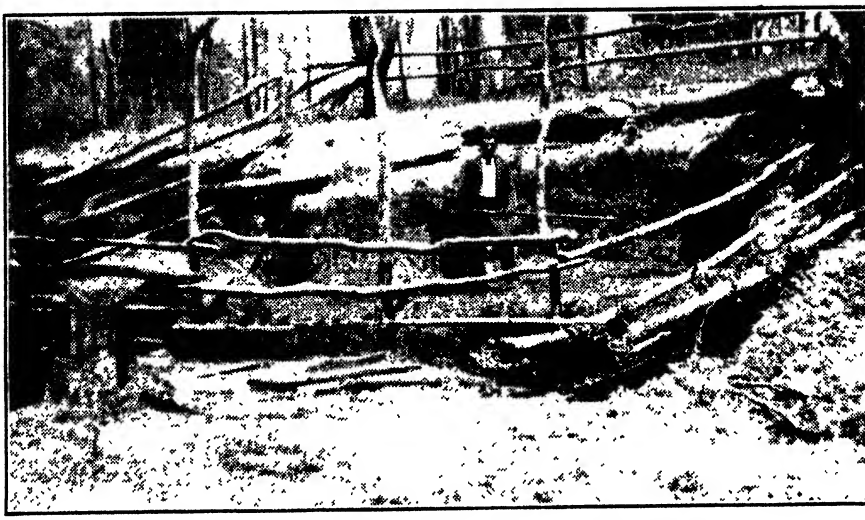
Mr. F. Holbrook.—A good stack of clover and grass silage with an excellent appearance.

Mr. H. M. Moulden.—Practically a pure grass silage, slightly acid, with a yellowish-brown colour. The wastage was greater in this stack than in the grass and clover mixture.

Mr. G. E. White.—A stack of oat, grass, and clover silage which varied from sweet to acid and of a brown to green colour. Much waste occurred from opening the stack from the sides.

Mr. W. Jenkins.—Stack composed almost completely of grass, slightly acid, dark brown to yellow. Wastage due to the sides not being sufficiently tramped, and the material used being cut rather too mature.

Mr. W. Bailey.—Stack composed of oats with peas on top; the edges resembled hay and the centre had over-heated. Wastage was due to the oats being cut too mature, but it was all readily eaten by stock. The pea silage was fed to the pigs with success.



Semi-hillside stack of silage. P J Trigwell, Donnybrook

DONNYBROOK DAIRY FARMERS' ASSOCIATION—SILAGE COMPETITION.

This competition, designed to encourage the use of silage, was the first organised by the above Association which is performing much useful work of special value to dairy farmers in the district.

Judging was carried out on 6th February with the following results:—

Name.	Material and Mixture.	Type, Palatability and Value.	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
R. J. Trigwell ...	20	30	27	10	8	95
H. T. Williams ...	17	25	25	9	7	83
A. Trigwell	15	23	25	8	8	79
C. J. Cunningham ...	17	23	23	8	7	78
W. J. Sears	16	21	18	6	7	68
J. G. Fry	12	18	18	5	6	59

The following notes regarding the exhibits were made by the Judge, Mr. G. K. Baron-Hay, Superintendent of Dairying:—

Mr. R. J. Trigwell.—A stack of 40 tons silage of the acid-fruity type, of excellent quality; cut second week in October, 8 days being required to complete the stack; waste 3 to 4 inches. Material almost wholly Subterranean clover, being light green in colour. (See illustration 1.)

Mr. H. T. Williams.—Stack approximately 54 tons, cut from 10 acres; sledge used in carting, which occupied 10 days; weighted with 3 tons of sleepers; cut second and third week in November, rain falling whilst stack being built. Material Lotus major, Subterranean clover and oats; acid type much relished by stock.

Mr. A. Trigwell.—35-ton stack, requiring 10 days to build: material carted with sweep costing 35s. to make: cut from 8 acres: sweet type, brown in colour; material cut too mature.

Mr. C. J. Cunningham.—30-ton stack; low clover content in material: sweet brown type of silage; material cut too mature.

Mr. W. J. Sears.—Stack approximately 40 tons; cut during second week in October; material too dry.

Mr. J. G. Fry.—Stack approximately 32 tons. Material largely grass, cut too dry during the middle of October. This stack was sunk 4 feet in the ground, thus saving some wastage and labour in building; considered a good plan if drainage good.

Farmers inspecting silage at Mr H T. Williams' Farm, Donnybrook. Note method of opening stack from top

NORTHAM AGRICULTURAL SOCIETY—SILAGE COMPETITION.

The competition, organised by the Northam Agricultural Society, has been conducted for a number of years and has been instrumental in not only demonstrating the great value of silage to the district but in raising the standard of the quality of silage made by all competitors. Judging took place on March 30.

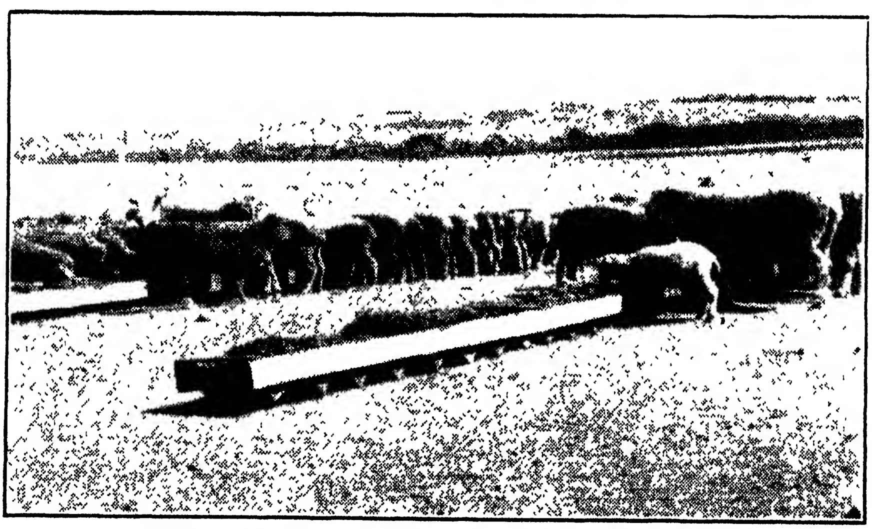
A special scale of points was necessary for judging in this district, as all silage exhibited was made in overhead concrete tub silos.

The competition was judged according to the following scale of points:—

1.	Material and mixture ensiled	20 points.
2.	Type, palatability, and value	30 "
3.	Percentage waste	30 "
4.	Time of cutting	10 "
5.	Method of feeding	10 "
	Total	100 "

The results were as follow:—

Name.	Material and Mixture.	Type, Palatability & Value.	Percentage Waste.	Time of Cutting.	Method of Feeding.	Total Points.
H. D. Morgan, "Irishtown" ...	20	23	24	8	10	85
W. G. Spencer, "Grass Valley" ...	10	25	28	7	8	78
D. Munro, "Lynden"	10	26	27	9	5	77
E. McManus, "Minathorpe" ...	10	23	27	7	5	72
M. Drake-Brockman, "Beechborough"	10	21	20	7	5	63



Feeding silage to ewes with lambs. H. D. Morgan, Northam.

The following notes regarding the exhibits were made by the Judge, Mr. G. K. Baron-Hay:—

Mr. H. D. Morgan.—Mr. Morgan filled his two 80-ton silos from 24 acres of oats and peas. This mixture has been demonstrated to give far better returns when fed than where a cereal crop only is ensiled. Mr. Morgan experienced trouble with his sheep prior to silage being fed, owing to their depraved appetite for rabbits, dung, and carcases. 950 sheep, together with 13 head of cattle, were being fed 2 to 3 lbs. silage per day. The silage was of excellent quality, being of the sweet fruity type.

Mr. W. G. Spencer.—30 acres of oats filled two 80-ton silos. All stock on the farm are being fed silage, *i.e.* sheep, cows, pigs, and horses. 900 sheep are being fed 2½ lbs per day, the silage being sufficient to feed from the beginning of February until the end of June. Sows received very little else. The silage was of excellent quality, being of the sweet fruity type.

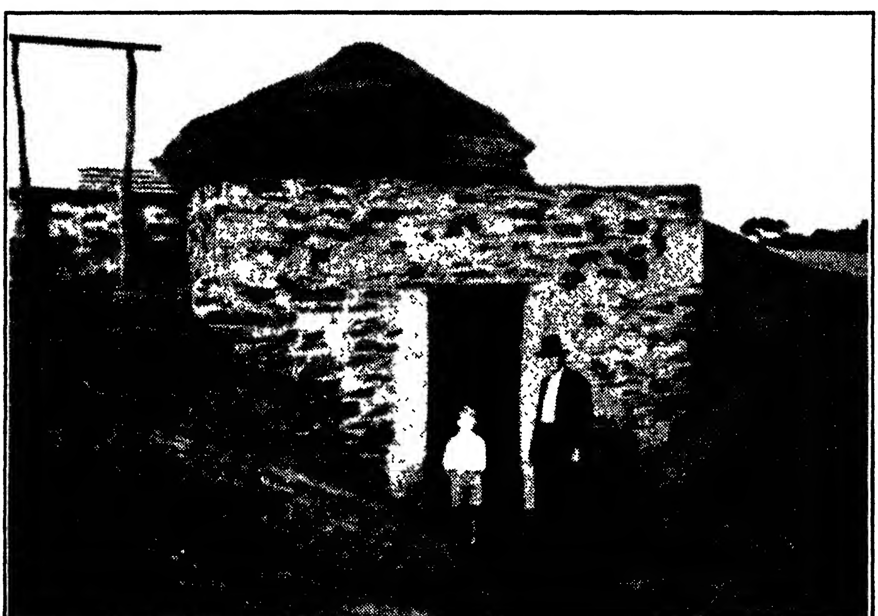
This crop was ensiled after the Royal Show. Best results in this district are obtained by cutting early prior to the Royal Show.

Mr. D. Munro.—30 acres of "Mulga" oats produced 185 tons silage. In previous years Mr. Munro cut his crop when too mature, but this season the crop was ensiled at the end of September and early in October, the silage being of excellent quality.

Mr. Munro conducts a dairy and feeds 42 cows and 13 yearlings throughout the summer, the cows averaging just under two gallons milk per day, which is an extremely good average. This would be quite impossible without silage.

Mr. E. McManus.—45 acres of oats produced 155 tons silage, which is used for feeding to 30 head of dairy cattle. An excellent sample of silage was seen, being acid-fruity in type.

Mr. McManus estimated the cost of producing silage at from 7s. 9d. to 12s. per acre, the cost varying as to whether the area required to produce the silage is 25 acres or 40 acres.



A trench silo in 1930, converted in 1931 by Mr. M Drake-Brockman

Mr. M. Drake-Brockman.—The silo here was originally a trench silo, the ends of which had been blocked by a stone wall and raised approximately 6 feet above the ground. The silo was 13 feet high by 25 feet long by 10 feet wide; capacity approximately 55 tons. The cost of building the walls for this silo was £20.

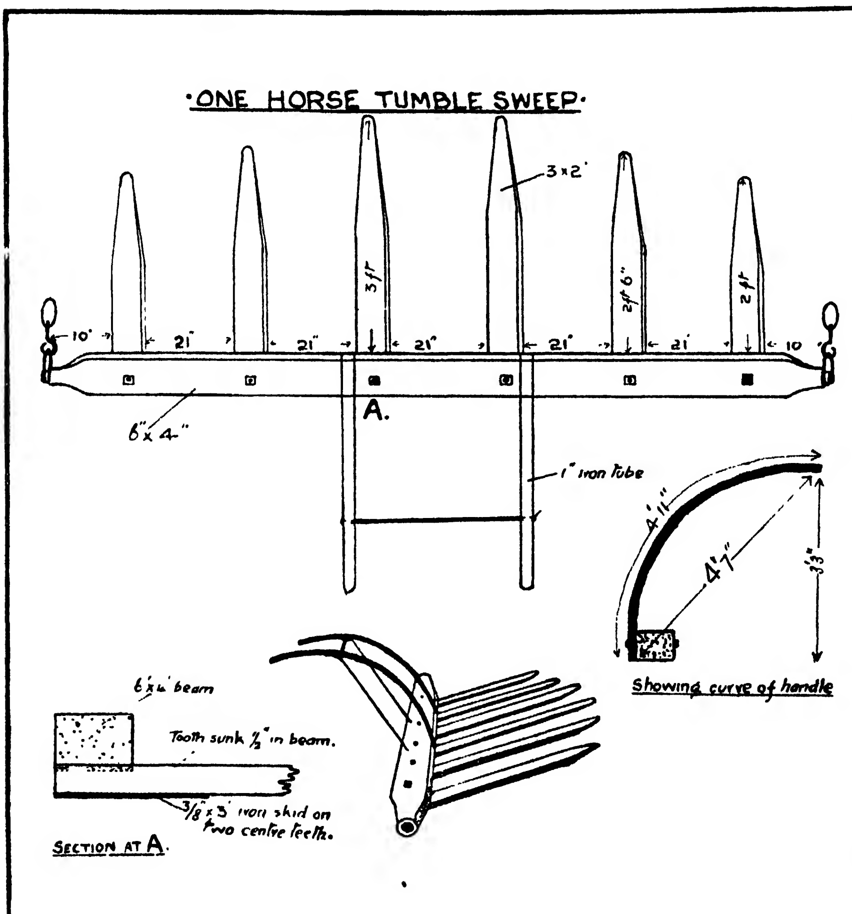
Mr. Brockman first tried silage in 1930-31 in a trench, but, owing to the difficulty of excavating the silage, decided to convert the trench into a cheap tub silo.

The results show that good silage can be made in a variety of ways, and that, although the overhead concrete silo is an advantage, the capital cost involved in same may be saved by the use of a type such as that tried by Mr. Brockman. 150 sheep were being fed on the day of inspection, but 500 were to be fed in addition at an early date.

NOTES ON PRODUCTION OF SILAGE.

The results of these competitions have brought out a number of points which it is necessary to observe in order to make silage efficiently. As most of these, however, have been dealt with already in previous numbers of the Journal, which are now obtainable as reprints,* available on application at the Department of Agriculture, only a brief mention is necessary.

1. Any green crop may be ensiled. Cereals, however, are unsuitable for building into stack silage, owing to high percentage of waste.



Plan of details of One-horse Tumble Sweep.

* *Journal of Agriculture*, September, 1930, "Cheap Face-cut Silos." *Journal of Agriculture*, March, 1930, "Stack Silage." Bulletin 211: "Silage, Ensilage and Silos."

2. Best results are obtained with stack silage where herbage contains a large percentage of leguminous plants.

3. Grass should be cut for silage before seed heads form, as the percentage of fibre increases very rapidly with maturity, leading to waste during fermentation owing to access of air.

4. Clovers should be cut while forming seed and before wilting commences.

5. A cereal and pea silage will give better results when fed to stock than silage from a cereal crop only. Owing to the difficulty of growing these two crops together, a system of sowing in alternate strips is recommended. The strips are cut across with the binder and are mixed automatically during cutting and blowing into silo.

6. *Handling the Material.*—Almost the only expense incurred in the making of stack silage is that of handling the crop, which, without labour-saving devices, may be unnecessarily high.

The heavy work of loading green material on to drays or wagons may be considerably lightened by the use of the "Tumble Sweep."

One-horse Tumble Sweep.—Reference to the accompanying illustrations will show the principle of the sweep, which may be used for handling green or dry material. Full details regarding construction also are given in the attached plan.

7. The stack should be round or square; never oblong, and preferably round. Stacks of less than 20 tons are not recommended.

The following table shows the dimensions of the base for stacks of varying capacities:—

	Round Diameter feet
20 tons	12
30 tons	14
40 tons	16
50 tons	18

8. *Yield of Grass Silage per acre.*

A good crop of subterranean clover fifteen to eighteen inches high will yield approximately 7 tons of green material per acre, equal to a 2-ton hay crop.

9. The base of the stack should be level and built on a well-drained site.

10. Care should be taken not to always unload at the same side of the stack, otherwise this section will be unduly tramped, causing uneven settling. Build the stack as evenly as possible, keeping the surface level.

11. Cutting and carting should proceed simultaneously or as near to each other as possible. Wet weather will not affect silage making.

12. Building should proceed as rapidly as possible, as this keeps the temperature down, resulting in less fermentation losses and good quality silage.

13. During the last summer a number of stacks toppled over, caused by overheating on the exposed or windward side, leading to more rapid sinking. Some protection is advisable until settling is completed, such as a screen of bags or a tarpaulin, or even brushwood, to break the force of the drying wind.

One-horse Tumble Sweep being operated on farm of Messrs Bayley Bros, Denmark.

14. When completed the stack should be weighted to ensure even settling. A row of sleepers around the edges, the centre being filled with earth to a depth of 12 inches makes a good seal.

A layer of bags of earth is preferred by some farmers and is quite effective.

Showing tumbling action of sweep, minimising handling the material.

15. Stacks should be opened from the top, a full layer not less than 1½ inches thick being removed each day. Opening from the sides exposes a fresh surface unduly, causing waste.
16. Good clover silage does not need the addition of a concentrate when fed to cows of average production. When silage is made from grass or cereal crops, however, disappointing results are obtained where fed alone to milch cows, ewes, or lambs. The addition of a concentrate, such as oats, bran, linseed meal, peas, etc., is then necessary to increase the protein content, otherwise supplied by the leguminous crop.

FIELD EXPERIMENTS WITH MANGANESE ON WHEAT AND OATS, 1931.

MURESK AGRICULTURAL COLLEGE,

H. J. HUGHES, Principal, and J. H. RICHES, Experimentalist.

Except for a period of exceptionally cold weather in June, which retarded growth somewhat but may have induced greater stooling, the season was favourable for crops.

The monthly rainfall, as recorded at the College, together with the averages since its inception in 1926, and the averages for Northam, nine miles distant, are given in the following table:—

TABLE 1.—RAINFALL.

Period.	Jan	Feb	Mar	Apl.	Growing Period. May	June	July.	Aug	Sept	Oct.	Total	Nov	Dec	Total.
1931 .. .	0	20	23	85	383	167	397	374	275	60	1,656	2	28	1,814
Average 6 years, 1926 1931	19	23	113	67	211	329	484	257	162	92	1,535	34	30	1,821
Av'age Northam, 45 years ..	29	41	67	80	222	330	332	258	167	99	1,408	38	35	1,698

The soil on which the experiments were planted was fairly heavy, part of it overlying an epidiorite dyke. It was fallowed during 1930, springtyne cultivated in November and prior to seeding. The experiments were planted on 6th June.

The results obtained are set out in the accompanying table:—

MANGANESE EXPERIMENTS.

Wheat Section.

Variety—Nabawa. Rate of Seed—60lbs. Rate of superphosphate—112lbs.

Manganese Sulphate per Acre.	Computed Yields per Acre: Section 1.		Section 2.		Section 3.		Section 4.		Section 5.		Average.		Percentage Yields
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28 lbs. ...	17	26	19	23	24	33	27	27	25	12	22	48	104
Nil ...	14	32	19	23	24	52	26	29	24	32	21	58	100
56 lbs. ...	17	46	22	37	26	29	25	50	21	19	22	48	104

Oats Section.

Variety Mulga. Rate of Seed—60 lbs. Rate of Superphosphate—112 lbs.

Manganese Sulphate per Acre.	Computed Yields per Acre.												Percentage Yields.
	Section 1		Section 2.		Section 3		Section 4.		Section 5.		Average.		
	bus	lbs.	bus.	lbs.	bus	lbs	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28 lbs.	47	20	*		52	32	58	5	53	12	52	37	100
Nil	52	13	54	30	56	8	55	29	47	0	52	33	100
56 lbs.	53	12	53	12	54	11	51	14	28	23	46	35	89

* Part of the yield of this plot was accidentally lost; Section 2 was, therefore, excluded in computing the averages.

It would be unsafe to generalise on one year's results, but it appears unlikely that the application of manganese to wheat and oats crops would prove profitable on soil similar to that tested.

FARMERS' FIELD TRIALS, 1931.

A. S. WILD, Agricultural Adviser.

BENN BROS., BOSCABEL.

Wheat Variety Trial.

During 1931 a wheat variety trial was conducted on the property of Messrs. Benn Bros. at Boscabel, situated about thirteen miles North of Kojonup.

The soil on which the experiment was planted varied from a sandy loam to a gravelly loam and originally carried white gum, jam and sheoak timber.

The ground was prepared by ploughing 3½in. deep early in September with a mouldboard plough. It was then left until April, when it was springtyne cultivated.

The following are the monthly rainfalls as recorded at Boscabel during the year, together with the average rainfall:—

	Jan	Feb.	Mar.	Apl	Growing Period							Nov	Dec.	Total for year.
					May	June.	July.	Aug	Sep.	Oct.	Total.			
1931	1	15	137	149	220	231	303	412	398	86	1,650	27	76	2,055
Average, 16 years ...	46	55	118	137	305	377	370	289	244	167	1,752	66	41	2,215

All plots germinated well and growing conditions early in the season were fairly good. The Bencubbin and the control variety, Steinwedel, made particularly forward growth and appeared better than the Nabawa. By the middle of September, however, the ground had become excessively wet, and this checked the growth of all varieties. Both the late varieties, Yandilla King and Sutton, appeared to suffer particularly from these wet conditions.

The following table shows the results obtained from the experimental plots, each of which was .4 acre in area:—

Planted 1st May. Rate of Seed—60lb per acre Rate of Superphosphate—112lb per acre

Variety.	Computed Yield per acre						Percentage Yield per acre
	Section 1.		Section 2		Average		
	bus	lb	bus	lb	bus	lb	%
Nabawa	9	12	5	7	7	10	54
Steinwedel (Control)	15	25	11	2	13	14	100
Bencubbin	15	0	17	0	16	0	121
Yandilla King	7	30	8	22	7	56	68
Steinwedel (Control)	8	47	14	30	11	39	100
Sutton	2	17	5	50	4	4	35

These results indicate that, under the conditions of growth at Boscabel during 1931, the most prolific variety is Bencubbin.

S. W. SANDELLS, LAKE BIDDY.

In addition to the Manganese Fertiliser Trial described in another article, a wheat variety trial was conducted on the property of Mr. S. W. Sandells, Lake Biddy.

The site of the experiment was adjacent to the Lake Biddy townsite. The land consisted of a loamy soil which originally carried blackbutt, morrel and silver salmon timber. It had been ploughed with a mouldboard plough during July, 1930, springtyne cultivated in October, again in March, and finally immediately proir to seeding.

The following table shows the rainfall as recorded at Lake Biddy during the year:—

——	Jan.	Feb	Mar	Apl	Growing Period							Nov	Dec	Total for Year
					May	June	July	Aug.	Sept	Oct	Total			
1931 ...	.	25	25	51	199	127	163	287	199	58	1,033	18	20	1 172
6 years average	15	15	154	77	157	208	231	170	142	72	980	61	52	1,354

The scantiness of the autumn rains was not conducive to working the fallowed land preparatory to seeding. Only 101 points were recorded up to the end of April. The June and July rains were also below the average.

Heavy and excessive frosts and general cold conditions during the early portion of the growing period prevented vigorous growth. Late frosts early in October also probably caused some damage to the maturing crops.

The following are the results obtained from the Variety Trial:—

WHEAT VARIETY TRIAL.

S. W. SANDELLS—LAKE BIDDY.

Planted on 28th May, 1931. Seed—45lb. per acre. Superphosphate—112lbs. per acre.

Variety.	Maturity.	Computed Yields per acre				Average Yields per acre, 1931.		Percentage Yields, 1931.
		Section 1.		Section 2.				
		bus.	lb.	bus.	lb.	bus.	lb.	%
Nabawa	Midseason	6	36	7	44	7	10	84
Gluyas Early	Early	8	30	8	40	8	35	100
Benenbbin	Midseason	9	36	9	50	9	43	113
Carrabin	Early	8	24	9	44	9	4	102
Gluyas Early	Early	8	0	9	46	8	53	100
Merredin	Early	6	4	9	12	7	38	86
S.H.J	Early	5	48	7	38	6	43	84
Gluyas Early	Early	5	48	10	12	8	0	100
Noongaar	Very early	5	0	7	8	6	4	76

These results demonstrate the suitability of the midseason variety, Benenbbin. The early maturing varieties, Gluyas Early and Carrabin, have also shown to advantage.

The results indicate that the varieties Benenbbin and Gluyas Early may be recommended with confidence for planting in the Lake Biddy district.

BETTER DAIRYING COMPETITION.

G. K. BARON-HAY, Superintendent of Dairying.

During the last year the West Australian Committee of the Australian Dairy Council, with the co-operation of the Department of Agriculture, conducted a Dairy Farm Competition with the object of encouraging increased butter production and improved methods of dairy farming.

The competition was of a most comprehensive nature, taking into account every phase of dairy farm activity.

The country embracing the Clover or Dairy Belt (*i.e.*, land having a rainfall of 20 inches or more) was divided into seven zones, with a special zone for farms on irrigation areas.

The Central Agricultural Society in each zone co-operated with the Department in distributing literature and in receiving entries. The respective Societies were:—

Zone 1.—Agricultural Society, Harvey.

Zone 2.—Wellington Agricultural Society, Bunbury.

Zone 3.—Agricultural Society, Busselton.

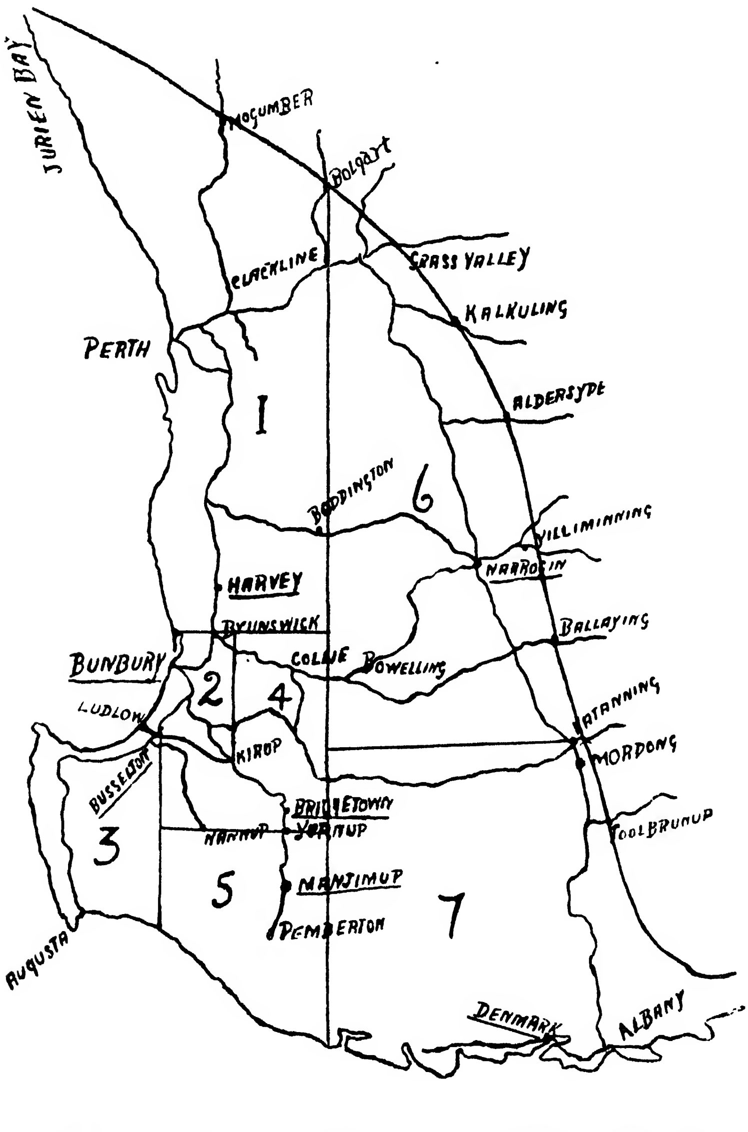
Zone 4.—Agricultural Society, Bridgetown.

Zone 5.—Agricultural Society, Manjimup.

Zone 6.—Agricultural Society, Narrogin.

Zone 7.—Agricultural Society, Denmark.

The zones are shown in Illustration 1.



In allotting the boundaries of these zones, an endeavour was made to group farms under as identical conditions as possible.

The headings under which competitors were judged and the points allotted were as follow:—

		Maximum Points.
1.	Farm Management	75
2.	Dairy Herd	100
3.	Pasture and Fodder Crops	100
4.	Fodder Conservation	150
5.	Utilisation of Separated Milk for Pigs, Poultry, etc.	25
6.	Butter Fat Production: 1st January to 31st December .. .. lb. / Acres devoted to Dairy Farming	50
	Total	500

It will be seen that great importance was attached to fodders and their conservation, as 250 points out of a total of 500 were allotted to these sections.

Owing to the large area covered by the competition, rainfall ranging from 20 to 70 inches, it was found necessary to judge the farms in zones during different times of the year, as follows:—

Zone 1. Judged 1st December, 1931.

Zone 2. Judged 1st December, 1931.

Zone 3. Judged 15th December 1931.

Zone 4. Judged 1st December, 1931.

Zone 5. Judged 15th December, 1931.

Zone 6. No entries.

Zone 7. Judged 1st January, 1932.

Irrigated Farms. Judged 1st February, 1932.

Prizes were offered in each zone as follows:—

First Prize—£8 8s. 0d.

Second Prize—£5 5s. 0d.

Third Prize—£2 2s. 0d.

Through the generosity of Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd., a Champion Prize of £10 10s. 0d. was offered, the First Prize winners in each zone being eligible to compete.

The following Tables (1-7) set out the points received by each competitor in the various zones:—

TABLE 1.—POINTS GAINED BY COMPETITORS.

ZONE 1.—HARVEY AGRICULTURAL SOCIETY.

—	Max. Points.	S. F. Russell.	L. Pearson.	L. Temple.	H. Masters.	R. Bee.	T. Briggs.	Mrs. C. Settor.
1. Farm Management .. . (75 points)								
(a) Lay-out and Convenience	30	28	20	22	20	22	15	15
(b) General Management, including, Sanitation, etc.	25	23	18	20	16	18	12	14
(c) Book-keeping and Records . .	20	20	20	17	18	15	15	15
2. Dairy Herd .. . .. (100 points)								
(a) Breeding—System of	25	20	20	25	20	25	25	20
(b) Dairy Type and Condition	30	22	22	27	18	27	25	20
(c) Bull (give particulars of breeding and production ancestry) .. .	25	25	25	25	20	25	25	25
(d) Pigs—breed, condition, etc .	20	13*	16	20	10*	17*	16	15*
3 Pasture and Fodder Crops .. (100 points)								
(a) Pasture	60	53	30	30	39	29	35	28
(b) Fodder Crops:—								
Freedom from Disease	3	3	3	3		3	3	3
Freedom from Weeds	7	7	7	6		7	6	5
Cultivation and Manuring	10	10	10	9		7	9	7
Evenness of Growth .	7	5	6	6		4	4	4
Yield	13	9	9	7		8	8	6
4. Fodder Conservation ... (150 points)								
(a) Silage—								
1 Succulency	20	16	16		18			
2 Mixture ..	20	16	15		20			
3. Type of Silage	10	7	7		8			
4 Percentage Waste	20	13	12		14			
(b) Hay -								
1 Mixture .	20	18	18	12	16	18	16	16
2. Condition .	20	18	20	17	16	18	15	16
(c) Amount of Fodder conserved per head	20	5	14	7	13	5	12	7
(d) General Lay-out for convenience in feeding	20	18	10	16	12	10	10	10
5. Utilisation of Separated Milk for Pigs, Poultry, etc (25 points)								
(a) Pigs	20		20	20			20	
(b) Poultry	5	3	5	3	3		5	3
6 Butter Fat Production*. (50 points)	50	48	23	41	35	42	23	27
Acres devoted to Dairy Farming . .		121	300	89	120	92	300	100
		400	391	336	316	300	299	256

* Whole Milk producer, heifer calves reared in good condition in place of Pigs.

J. P. Norton, Capel Cows grazing on water couch pasture, providing excellent succulent fodder during the summer.

TABLE 2.—POINTS GAINED BY COMPETITORS.

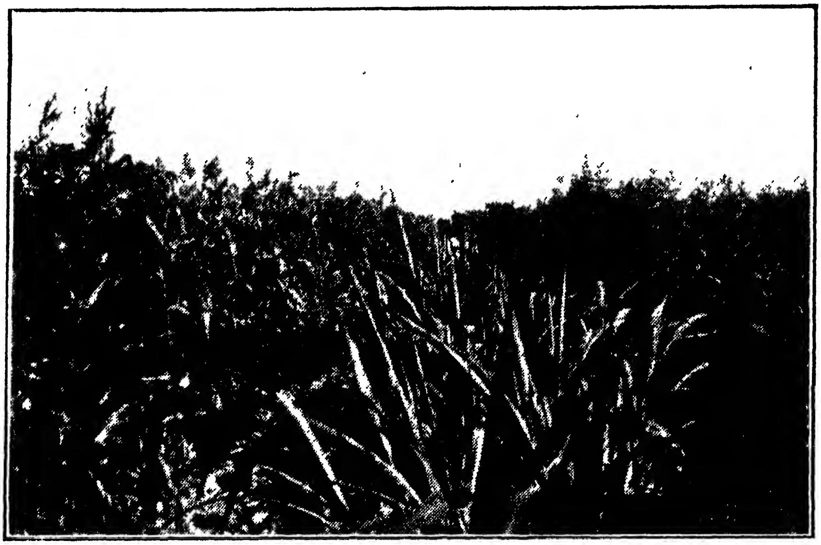
ZONE 2.—BUNBURY AGRICULTURAL SOCIETY.

	P. Rose.	B. Langridge.	J. P. Norton.	A. Frost.
Lay-out and Convenience	29	20	17	20
General Management and Sanitation	25	20	19	19
Book-keeping and Records .	14	20	16	14
System of Breeding .	25	22	19	21
Dairy type and condition .	30	26	23	26
Bull	25	20	18	19
Pigs	20	18	12	10
Pasture . .	40	46	58	51
Fodder Crops .	4	10	5	7
Silage—				
Succulency .	18	15	18	.
Mixture . . .	17	18	17	...
Type	9	5	8	.
Waste	10	8	11	
Hay—				
Mixture . . .	20	20	15	20
Condition	18	16	17	15
Amount per head ...	17	13	15	5
Lay-out of feeding	20	17	14	17
Utilisation of skim	20	22	18	20
Butter Fat production per acre ...	24	38	31	50
Total	385	374	351	314

TABLE 3.—POINTS GAINED BY COMPETITORS.

ZONE NO. 3. AGRICULTURAL SOCIETY, BUSSELTON.

—	Maximum Points.	A. Oldfield.	E. C. Melville.	A. Miller.	S. Smith	C. Ironmonger, Wonnerup.	M. Torrent.	H. Johnson.	Nilsson-Lynne.	T. Albutt.	P. O. Farrell	A. Albutt.	A. W. Langley.	A. H. Wilkinson.	R. W. Webb.	Reading Bros.	W. J. Cox.	W. J. Bryant.	O. H. Doyle.	T. Hugall.
Management ... ... (75 points)																				
Lay-out and convenience	30	28	20	16	26	20	16	20	22	22	24	26	20	20	20	18	20	20	22	20
General Management and Sanitation	25	23	18	15	22	15	12	15	15	17	20	18	15	15	18	15	14	15	17	15
Book-keeping and Records	20	18	15	18	18	15	15	15	15	15	16	16	15	18	20	15	16	15	18	15
Dairy Herd ... ... (100 points)																				
Breeding, system of...	25	20	25	20	20	25	15	20	20	20	20	20	20	18	15	20	20	20	15	18
Type and condition	30	23	25	25	25	30	20	20	17	25	25	25	18	25	14	18	16	17	18	20
Bull	25	25	25	25	25	25	15	22	25	25	25	25	25	20	..	25	25	25	15	
Pigs (breed and condition) ...	20	10	20	18	20	15	20	20	15	18	18	20	16	20	18	20	20	18	18	15
Pasture ... ... (100 points)	60	56	49	50	56	49	48	49	53	51	51	51	47	51	49	37	49	50	46	50
Fodder Crops—																				
Freedom from Disease	3	3	3	3	3	3	3	3	3	3	3	3	3	*Nil*	3	*Nil*	Trial plots only.	*Nil*	3	3
Freedom from Weeds	7	7	7	5	6	4	6	6	6	7	7	7	5	..	6	...		...	7	5
Cult and Manuring	10	9	8	9	9	7	7	9	9	9	9	9	7	..	8	...		..	10	7
Evenness of Growth	7	6	6	5	5	5	5	4	5	5	5	5	5	..	5	...		...	7	5
Yield	13	10	10	10	10	10	8	8	8	11	11	9	6	..	7	.		.	13	8
Silage—																				
Succulency	20	18	15	18	*Nil*	15	12	18	16	*Nil*	*Nil*	*Nil*	12	16	18	16	12	*Nil*	*Nil*	*Nil*
Mixture	20	18	14	16	20 pts. all for summer pasture	15	15	16	16	.	.	.	16	15	18	16	15	..	..	...
Type of Silage	10	9	7	9		7	5	9	8	..	..	..	5	6	8	8	5	...	...	...
Percentage Waste	20	14	14	15		14	16	18	14	...	..	..	13	14	...	14	11	...	...	...
Hay—																				
Mixture	20	18	18	18	18	18	18	18	18	18	18	16	16	18	18	16	16	18	18	16
Condition	20	18	18	18	18	18	18	16	18	18	18	18	12	16	16	14	14	16	18	16
Amount of Fodder per head	20	20	15	15	10	20	15	11	17	12	10	12	14	10	6	5	19	12	7	5
Lay-out and convenience of feeding .	20	15	10	12	20	10	10	10	12	12	10	15	10	10	14	14	10	10	14	10
Utilisation of Separated Milk for—																				
Pigs	20	20	20	20	20	10	20	20	14	15	20	15	7	7	20	.	20	20	14	20
Poultry	5	3	3	3	3	3	5	3	3	3	3	3	.	3	3	3	3	3	3	.
Butter Fat production per acre .	50	22	38	39	21	21	41	15	10	50	37	31	25	21	5	16	3	44	12	.
Acres used for dairying		acres 70	acres 88	acres 70	acres 68	acres 100	acres 50	acres 140	acres 72	acres 40	acres 51	acres 50	acres 120	acres 80	acres 40	acres 250	acres 57	acres 58	acres 50	acres 100
Total points .	.	413	403	402	375	374	365	365	359	356	350	344	332	323	319	310	308	303	295	250



Three excellent summer fodder crops: Maize, Elephant Grass and Sudan Grass
Planted January 13, 1931, photo. November 15, 1931, T. Briggs, Byford

TABLE 4.—POINTS GAINED BY COMPETITORS.

ZONE 4. AGRICULTURAL SOCIETY, BRIDGETOWN.

	H. Noon.	H. E Kendal	G. E. White.	J. Hearman.	F. W. Head	A Hayward	A Lindsay.	C T Wilkinson.	F. C. Wiseman.
Lay-out and Convenience ..	23	20	21	21	20	21	17	21	17
General Management and Sanitation	20	20	19	18	16	17	15	18	15
Book-keeping and Records . ..	15	15	8	13	4	4	7	12	10
System of Breeding . ..	21	19	17	18	17	15	13	17	16
Dairy, type and condition . ..	24	22	22	20	22	18	17	20	18
Bull . .	22	20	22	18	21	22	22	22	17
Pigs	20	14	15	8	5	12	10	8	7
Pasture ..	53	38	42	40	38	40	37	42	38
Fodder Crops .. .	20	13	5	10	8	..	...	15	10
Silage—									
Succulency	16	17	18	17	19	20	18	...	...
Mixture	17	17	20	18	18	20	17	...	...
Type . . .	7	8	8	8	10	10	8	...	...
Waste	2	12	12	15	11	18	12	..	...
Hay—									
Mixture	18	20	20	18	20	18	17	17	18
Condition	15	18	20	18	20	18	15	15	16
Amount per head	12	20	20	20	17	17	12	10	10
Lay-out for feeding	13	14	15	16	16	15	10	14	12
Utilisation of Skim Milk	23	18	21	20	22	22	22	18	20
Butter Fat production per acre	33	27	21	28	30	22	20	20	23
Total	374	352	347	344	334	329	291	269	247

TABLE 5.—POINTS GAINED BY COMPETITORS.

ZONE 5. AGRICULTURAL SOCIETY, MANJIMUP.

	Mr. and Mrs. Hugo Grumpelt.	W. Kjellgren.	H. C. Barnsby.	A. Kjellgren.	R. Nicol.	W. Cox.	H. Brown.	D. Hunter.	J. Prosser	G. G. Adams	J. Rising	W. H. Campbell	V. Martin	A. Eggington.
Lay-out and Convenience	21	20	19	25	15	15	27	17	19	20	15	17	14	20
General Management and Sanitation	24	23	23	23	18	15	25	21	20	21	15	18	15	20
Book-keeping and Records ..	15	5	7	5	.	5	5	5	10	5	5	3	10	
Breeding—System of	24	16	18	21	17	13	20	18	15	18	15	16	15	15
Dairy, type and Condition	25	18	22	22	18	17	25	20	18	20	22	18	19	18
Bull	22	21	.	21	23	21	24	22	22	19	22	21	23	20
Pigs ..	10	10	18	10	14	9	10	18		5	10	13	11	10
Pasture	45	43	42	43	42	37	46	38	38	40	38	38	36	37
Fodder Crop	..	5	10	5	10	10	27	20	10	20	30	25	20	10
Silage—														
Succulency	20	20	20	15	20	20		.						
Mixture	19	20	20	16	17	20	..				.			
Type	10	10	10	8	6	18	..	.						.
Condition	12	18	16	14	10	17	.	..						..
Hay Mixture	17	19	17	15	20	17	19	18	17	18	17	15	14	17
Condition	17	18	20	15	16	18	20	14	19	17	15	15	17	13
Amount per Head ..	18	20	20	17	20	20	15	11	17	15	12	10	12	13
Lay-out for Convenience	16	18	15	18	16	15	20	16	15	15	15	16	15	15
Skim Milk ..	20	21	22	20	22	20	23	20	13	20	22	20	22	18
Butter Fat per acre	30	33	37	24	31	21	20	38	18	22	18	22	22	11
Total	365	358	356	337	335	328	326	296	281	275	271	267	265	237

TABLE 6.

BETTER DAIRYING COMPETITION.

ZONE 7 — AGRICULTURAL SOCIETY, DENMARK.

——	Maximum Points.	F. C. Smith.	A. G. Pomeroy	L. Hargrave	P. Berridge.	E. A. Russell.	J. Illsley.	T. Minchin.
1. Farm Management ... .. (75 points)								
(a) Lay-out and Convenience	30	25	25	20	20	27	20	18
(b) General Management, including Sanitation, etc	25	25	20	20	20	25	20	17
(c) Book-keeping and Records .	20	16	..	10	13	15	10	10
2. Dairy Herd .. .. (100 points)								
(a) Breeding—System of	25	20	20	15	15	20	20	20
(b) Dairy Type and Condition	30	28	25	30	24	30	30	25
(c) Bull (give particulars of breeding and production ancestry)	25	25	25	15	15	25	25	25
(d) Pigs—breed, condition, etc . .	20	18	17	12	18	12	18	12
3. Pasture and Fodder Crops . (100 points)								
(a) Pasture	60	51	49	47	43	44	49	42
(b) Fodder Crops :—								
Freedom from Disease .	3	3	3	3	3	3	...	3
Freedom from Weeds ..	7	7	6	7	7	7	5	7
Cultivation and Manuring ..	10	9	6	7	7	9	7	7
Evenness of Growth . .	7	6	5	6	6	7	..	...
Yield	13	13	8	6	10	12	...	...
4. Fodder Conservation ... ... (150 points)								
(a) Silage :—								
1. Succulency ..	20	15	18	15	15	..	15	...
2. Mixture	20	16	18	18	17	..	16	...
3. Type of Silage .	10	8	8	8	6	..	8	...
4. Percentage Waste.	20	12	18	10	13	...	13	...
(b) Hay :—								
1. Mixture	20	20	18	18	19	18	16	18
2. Condition	20	18	18	18	18	19	16	18
(c) Amount of Fodder conserved per head ..	20	18	18	12	15	12	8	10
(d) General Lay-out for convenience in feeding	20	18	16	12	15	18	16	15
5. Utilisation of Separated Milk for Pigs, Poultry, etc. .. .. (25 points)								
(a) Pigs	20	} 15	20	12	16	15	16	15
(b) Poultry	5							
6. Butter Fat Production . .. (50 points)	50	33	24	42	25	26	15	14
Total . . .	500	417	385	363	360	344	343	276

TABLE 7.—POINTS GAINED BY COMPETITORS.

IRRIGATION ZONE.—HARVEY.

—	Maximum Points.	R. Hanks.	R. O. Hayward.	C. Heppingstone.	L. Prince.	W. Shaw.	Evans Bros.	R. Ibbotson.
Lay-out and Convenience of Buildings, etc.	30	22	24	26	23	22	18	18
Lay-out of Irrigation Scheme ..	10	8	8	7	9	8	7	7
General Management and Sanitation	20	16	17	18	16	17	13	15
Control of Water	20	6	5	5	13	20	5	9
Condition of Channels and Drains	10	7	8	8	8	9	7	5
Book-keeping and Records	20	15	20	15	20	20	15	15
Breeding—System of	25	25	20	15	22	22	15	20
Dairy Type and Condition of Stock	30	25	25	23	25	25	20	22
Bull—Breed and dairy type	25	25	23	25	25	25	20	22
Calves—Condition and Rearing	20	20	20	14	20	20	18	18
Pasture		24	32	36	32	16	32	30
Eveness of Growth .		17	22	26	22	8	24	20
Nutritive Value and Mixture		13	11	14	18	10	14	14
Freedom from Disease		15	20	20	20	15	20	20
Freedom from Weeds . .		12	16	18	18	12	18	16
Fodders—Freedom from Weeds		5	*Nil*	*Nil*		3	*Nil*	*Nil*
Cultivation and Fertilising		10				7		
Evenness of Growth .		4				3		
Yield or Condition		9				7		
Silage .		*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
Hay—Time of Cutting	10	10	10	10	5	9	9	*Nil*
Mixture	20	18	18	18	12	18	16	
Condition	20	18	18	18	16	16	17	
Protection	10	10	10	10	..	10	10	
Amount of Fodder per head	20	20	10	13	5	10	9	*Nil*
Lay-out and Convenience for feeding	10	8	8	8	4	8	8	4
Skim Milk—Pigs	15	15	9		2	4	10	13
Poultry	5	3	3	3	3	3		3
Butter Fat, yield per acre	50	33	46	50	34	17	39	19
Area devoted to Dairying	...	acres 50	acres 68	acres 45	acres 65	acres 200	acres 40	acres 30
Totals		413	406	400	372	364	364	290

CHAMPION DAIRY FARM.

The following competitors were eligible to compete for the Champion Prize offered by Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd., being the First Prize winners in each Zone:—

P. Rose, "Yeeralla," Burekup.
S. F. Russell, "Wendowie," Serpentine.
R. Hanks, "Sarnia," Harvey.
F. C. Smith, Group 41, Denmark.
Mr. and Mrs. Grumpelt, "Woodlawn," Manjimup.
A. Oldfield, Group 6, Forest Grove.
H. Noon, Katterup.

Judging was conducted by the Superintendent of Dairying, Mr. G. K. Baron-Hay, in order to ensure uniformity as between Zones, and farms were visited during the period April 5th to 21st, 1932.

The results are set out in the following table:—

TABLE 8.—POINTS AWARDED FOR CHAMPION PRIZE.

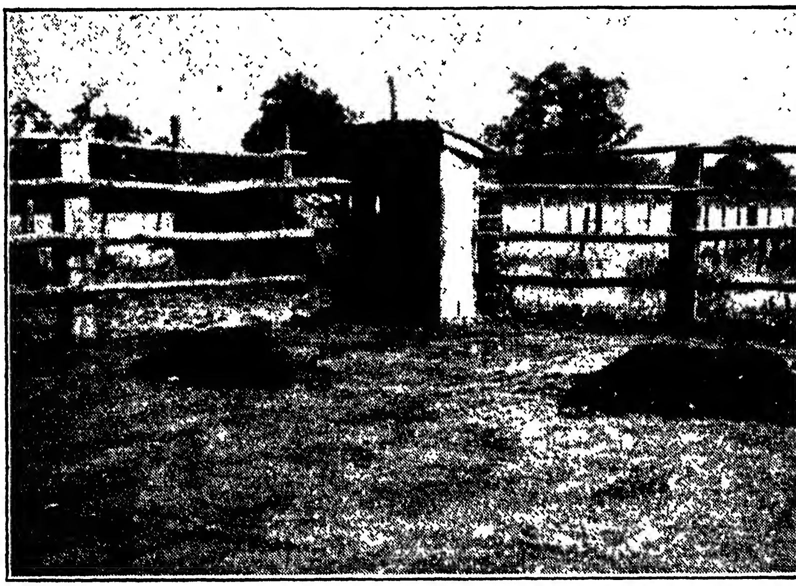
—	Maximum Points	P. Rose.	S. F. Russell	R. Hanks	F. C. Smith	Mr. and Mrs. H. Grumpelt.	A. Oldfield.	H. Noon.
1. Farm Management .. ... (75 points):								
(a) Lay-out and Convenience .	30	29	26	24	20	20	26	26
(b) General Management, including Sanitation, etc.	25	25	23	19	19	18	21	24
(c) Book-keeping and Records .. .	20	20	19	14	17	15	17	15
2. Dairy Herd ... ... (100 points)								
(a) Breeding—System of .	25	25	20	23	21	23	21	23
(b) Dairy Type and Condition . ..	30	25	23	25	22	23	19	21
(c) Bull (give particulars of breeding and production ancestry)	25	25	25	25	20	25	20	25
(d) Pigs—breed, condition, etc . .	20	18	13	14	17	10	12	14
3. Pasture and Fodder Crops								
(a) Pasture . . .	60	55	53	*90	50	45	50	53
(b) Fodder Crops .	40	20	40	25	32	..	25	33
4. Fodder Conservation .. ... (150 points).								
(a) Silage —								
1. Succulency .	20	18	16	..	15	†25	18	16
2. Mixture	20	17	16	..	16	25	18	17
3. Type of Silage . .	10	9	7	..	8	20	9	7
4. Percentage Waste . .	20	10	13	..	12	25	14	2
(b) Hay —								
1. Mixture	20	20	18	*28	18	17	18	15
2. Condition . .	20	18	18	*28	17	17	18	18
(c) Amount of Fodder conserved per head .	20	10	5	9	20	12	19	4
(d) General Lay-out for convenience in feeding	20	20	18	18	15	17	16	17
5. Utilisation of Separated Milk for Pigs, Poultry, etc.—(25 points)								
(a) Pigs	20	20	..	14	18	12	15	14
(b) Poultry	5	3	3	3	..	...	3	3
6. Butter Fat Production per Cow—(50 points).	50	50	39	48	50	42	26	34
Total ..	500	437	‡411	407	407	391	385	381

* Irrigated farm. No silage considered necessary. † Silage in place of Fodder crops. ‡ Whole Milk supplier. No pigs reared. Allowance made—16 pts.

Judging was extremely difficult owing to the various methods of management adopted by farmers which are dependent to a great extent on the climatic conditions. For instance, some farmers relied on adequate supplies of silage in place

of summer crops; the owners of irrigated farms considered silage unnecessary, etc. Where the management, however, was in the opinion of the Judge responsible for the provision of adequate fodder reserves, due credit was allowed in allotting points.

It is not proposed to give detailed information regarding the farms owned by the various competitors, as this already has been published by the Judges in presenting their reports on the Zone Competitions. An effort has been made, however, to glean information from the competition which will be useful to readers in the conduction of their own farms.



Good management on Mr. S. F. Russell's Farm. Manure is removed daily and carted to fields weekly. Phosphatic lick always available in sheltered bin.

1.—FARM MANAGEMENT.

The layout of the various farms in the competition show the need for careful planning before a property is developed. It is noticeable that where the holdings have been developed by their owners from the virgin state, particularly in Zones 3 (Margaret River), 5 (Manjimup), and 7 (Denmark), the layout is usually good. The farms owned by Messrs. P. Rose, S. F. Russell, and H. Hanks also exhibit careful planning.

The general layout to be aimed at is one that will lend itself to controlled grazing, having in mind the necessity for small paddocks which should be accessible from centrally placed races with provision for the watering of stock.

In general, the records being kept by farmers do not give sufficient data to enable the owner to ascertain what departments of his farming activities are profitable. The dairy farm should be essentially a mixed farm embracing the production of butter fat and pigs, with poultry and perhaps cropping as sidelines. Records should be kept showing the expenditure required by each department and also the returns obtainable from the sale of that produce. In only a few instances were complete records being kept regarding the weight of milk being yielded by the individual cows in the herd.

2.—DAIRY HERD.

The winning farm, "Yeeralla," owned by Mr. P. Rose, is conducted on lines which would be considered suitable for the majority of dairy farms in the South-West. This farm consists of 600 acres of undulating country, 400 acres being cultivated. As the area was taken up in the virgin state, provision was made for fencing so that paddocks would be square or rectangular, there being now 24 paddocks for grazing—5 of 5 acres and 19 of 10 to 20 acres each.

The herd consists of 74 cows, being almost entirely pure bred Jerseys bred by the owner during the last 14 years.

The policy in the development of this herd has been a consistent one of breeding for production by the use of herd sires from tested cows in the "Melrose" Stud owned by Mr. W. Woodmason, Victoria.

The herd of 74 cows averaged 252 lbs. butter fat without allowances during the year, which in view of the fact that very little purchased concentrates are fed is extremely good.

The foundation of the herd was laid in 1920 by the purchase of 8 cows and the bull "Reveller of Melrose (1804)" ex "Graceful Duchess 14th" by "Golden Fern's Viscount."

The following is a record of the bulls that have assisted in maintaining and improving the high standard of production in this herd:—

Name of Bull.	Dam.	Production. Average Test.	Production. Butter Fat.
		%	lb
1920—Reveller of Melrose ...	Graceful Duchess 14th ...	6·16	466
1923—Grafter of Melrose ...	Vanilla 5th of Melrose ..	5·17	452
Colonel of Melrose ...	Blossom 5th of Melrose ...	6·29	467
1927—Romeo of Melrose ...	Vanilla XI. of Melrose ...	5·59	424
Raleigh of Melrose ...	Jessie 36th of Melrose ...	5·89	269 H.
1929—Sultan of Melrose ...	Graceful Duchess 41st... ...	5 84	354 J. 3
Melrose Clarion ...	Jessie 36th of Melrose ...	5·89	269 H.
1930—Melrose Liberty ...	Werribee Fancy's Clementine 2nd	..	605
Average Butter Fat Production of Dams, with allowances ...			461

It is pleasing to state that the policy adopted by Mr. Percy Rose, as briefly outlined above, is that followed by practically all competitors, for out of the 67 bulls owned by competitors no less than 61 are pure bred and 41 are not only pure bred but ex tested dams

It is interesting here to compare with this the results which have been achieved in this State in the elimination of poor quality bulls since the initiation of "The Dairy Cattle Improvement Act, 1924," which may be briefly shown as follows:—

1924—Percentage of pure bred bulls .. .. .. 23 per cent.

1931—Percentage of pure bred bulls .. .. .. 53 per cent.

Percentage of pure bred bulls owned by competitors .. 91 per cent.

The results being achieved by such practical dairymen as those leading in each Zone must commend themselves to all dairy farmers throughout the State,

Mr. P. Rose's Herd of Pedigreed Jersey Cows, "Yeeralla," Burekup.

and it is hoped that the use of "Standard" bulls, i.e., bulls ex tested dams, will continue to increase.

The far-reaching effects of a stud bred as above is also indicated in the herds of leading competitors, as Mr. H. Grumpett, winner in Zone 5, and Mr. B. Langridge, second to the champion, are both building up their herds on stock obtained from the "Yeeralla" stud.

Two-year-old Heifers, Mr. P. Rose, Burekup. Progeny of Romeo of Melrose and Raleigh of Melrose.

TABLE 9.—PER CENT. OF "STANDARD" BULLS.

Zones.	No. Bulls ex Tested Dams.	Average Production of Dams—without allowances.
1	6	387 lbs. butter fat.
2	3	491 ,, ,,
3	11	395 ,, ,,
4	4	391 ,, ,,
5	13	352 ,, ,,
7	4	350 ,, ,,
Average	41	382 lbs. butter fat

Per cent. "Tested Bulls" owned by competitors—67 per cent.

PIG-BREEDING.

The majority of competitors were paying attention to the breeding of pigs as a side-line, 56 out of the 62 competitors owning breeding sows.

The following table shows a comparison of the number of sows to milch cows:—

TABLE 10. COMPARISON OF NUMBER OF SOWS TO COWS.

——	No. of Cows.	No. of Sows.	No. of Sows to Cows.
Zone 1	222	13	1 : 17
Zone 2	184	41	1 . 4·5
Zone 3	Information not	available.	
Zone 4	158	29	1 : 5·4
Zone 5	290	39	1 . 7·7
Zone 7	96	19	1 : 5
Average	...	...	1 · 6·7

It will be noticed that in Zone 1 only one sow on the average is kept to 17 cows. This may be accounted for by the fact that four out of the seven competitors in Zone 1 supply the metropolitan area with whole milk.

In the remaining zones the number of cows varies from 4½ to 7½ per sow, which is usually the number found most profitable in that the skim milk produced by these cows is sufficient to rear the progeny of the sows.

A weakness noticed in the feeding of skim milk to pigs was that the necessary grain required to top off baconers or porkers is in many cases not supplied. This can be grown on the farm, and good crops of barley or peas can be grown in the South-West for feeding to pigs.

The winner, Mr. P. Rose, has developed on sound lines the pig-breeding side of dairy farming. Peas are grown for feeding and topping off baconers and porkers, the sows being grazed through the greater part of the year. Barley or rape is sown for grazing, while the fattening pigs—in addition—receive skim milk with grain grown on the farm.

As in the breeding of dairy stock so in the breeding of pigs, competitors in every instance realise the importance of a pure bred boar.

The distribution of breeds is shown in the following table, and the large predominance of the Berkshire and Tamworth breeds will be noticed.

TABLE 11.—BREEDS OF PIGS OWNED BY COMPETITORS.

Number of Farmers.	Breed of Sows.	Pure Bred Boars.
27	Berkshire x Tamworth	Middle Yorkshire (4)
14	Berkshire	Berkshire (14)
6	Berkshire x Middle Yorkshire	
4	Tamworth	
2	Tamworth x Middle Yorkshire	
1	Middle Yorkshire	
1	Large Black	
1	Large Black x Middle Yorkshire	

3. *Pasture and Fodder Crops.*- The type of pasture generally, except on the irrigated areas or on specially damp summer land, was composed of annual plants, the predominating clover being Subterranean Clover which was replaced in the Busselton area by Drooping Flowered Clover. This clover has revolutionised the development of light sandy soil overlying clay and which is extremely wet in the winter months, and was first brought into prominence in this district by Messrs. Reading Bros. at Newtown.

Cheap Land Development. Reading Bros., Newtown. Drainage essential. First year after sowing with Drooping Flowered Clover and 1 bag of superphosphate per acre

In the development of land with the use of this clover drainage is the first consideration, and can be economically carried out by means of the Martin Ditcher. The area is then sown with Drooping Flowered Clover seed, either in the form of clean seed, or seed in chaffed material which has been swept from the fields, or clean seed which has passed through the animal and is applied to the land mixed with farmyard manure. This latter method is the one favoured by Messrs. Reading Bros., who yard their cows each night during the summer months and whilst they are being fed hay. The droppings from these cows contain large quantities of seed, the manure being pulverised by the continued tramping of the cows, and is sown early in autumn.

The remarkable results obtained by the sowing of this clover are shown in Illustrations 6-8.

Second year after annual top-dressing with 1 bag superphosphate.

On the older areas there are indications that the development of permanent pasture plants will gradually extend throughout the South-West, the soil in the initial years after clearing being too low in nitrogen content to make the cultivation of high-fertility perennials, partcularly the Rye Grasses, practicable.

From the above it will be conceded that the provision of succulent fodder during the summer months is essential for successful dairying in the South-West at the present stage of development. In general, the results of this Competition show that too little attention is paid to summer fodder crops. Only two-thirds

After third annual application of 1 bag of superphosphate per acre Growth almost entirely Drooping Flowered Clover

of the competitors grew fodder crops of any kind, and in very few instances was the area adequate to provide succulent feed for the herd, the area sown ranging from one-quarter acre to six acres. The area planted bore no relation to the number of cows being milked and generally, during the past dry summer, stock have suffered from the lack of succulent fodder.

The acreage of summer fodder grown in each zone is shown in the following table:—

TABLE 12.—ACREAGE OF GREEN FODDER PER COW.

—	Number of Cows.	Summer Fodders.	Acres of Summer Fodders per Cow.
		acres.	acre.
Zone 1	162	14·50	0·09
Zone 2	42	3·25	0·08
Zone 3	200	24·75	0·12
Zone 4	84	11·50	0·14
Zone 5	180	23·25	0·13
Zone 7	96	30·25	0·32
Average all competitors	...	...	0·14

The farms where silage has been made in order to provide succulent fodder, and also farms where irrigation is possible, have been omitted from Table 12.

Taking into account the wide areas over which the farms were scattered in each zone, it is remarkable that the average acreage of summer fodders per cow is as

constant as that shown in the table, and, it will be conceded, is far below a desirable area, at least half an acre being required unless ample silage is conserved.

It is true that the provision of silage might account for the small area of summer fodders grown, but a perusal of the notes on fodder conservation given below will show that, on the average, the reserve of fodder for the summer months has been quite inadequate.

Mr. S F Russell's crop of Maize, Serpentine This farmer leads in the production of summer fodder, growing Lucerne, Cow Peas, Elephant Grass, and Maize

4. *Fodder Conservation.*—Fodder conservation was considered by the Committee responsible for organising the competition as likely to be *the most important factor* in the more economical production of dairy produce in Western Australia. Throughout the greater portion of the South-West, there is a period of at least four months during which succulent fodder may be lacking and should be provided either in the form of fodder crops or as conserved fodder in order to maintain production during that period.

The dairy farm practice of a few years ago whereby cows were milked during the rainy season from July to December is only found in isolated cases, and a system whereby production is spread throughout the year is now being found profitable and is advocated. This will greatly assist butter manufacturers to reduce costs of manufacture and also will tend to enable a larger return to be made to the farmer, by reason of the fact that importations would not be necessary during the lean months as at present, and export would not be confined to the flush period of the year only.

The results of the competition show that further conservation of fodder is essential for the interests of the dairying industry. Even among the competitors, some of whom may be assumed to be the leading dairy farmers in their district, the conservation of fodder is obviously the weak point in the management of the farm.

Table 13 sets out in a concise manner the average tons of fodder conserved per cow in each zone, and, for comparison, the tons of fodder conserved by a leading farmer in that zone—

TABLE 13.—AVERAGE TONS OF FODDER CONSERVED COMPARED WITH HIGHEST RESERVE IN EACH ZONE.

—	Cows.	Hay.	Silage.	Reserve per Cow. Hay.	Reserve per Cow. Silage.	Reserve per Cow calculated as Hay.*
Zone 1—Average	222	170	55	0·76	0·24	0·84
T. Briggs	**32**	**130**	...	**4·06**	...	**4·06**
Zone 2—Average	184	142	144	0·40	0·40	0·53
P. Rose	**74**	**85**	**80**	**1·15**	**1·08**	**1·51**
Zone 3—Average	360	403	340	1·12	0·90	1·42
A. Oldfield	**16**	**50**	**40**	**3·12**	**2·50**	**3·95**
Zone 4—Average	158	194	119	1·23	0·75	1·48
H. E. Kendall ..	**25**	**52**	**18**	**2·08**	**0·72**	**2·32**
Zone 5—Average	290	444	205	1·53	0·71	1·76
W. Kjellgren ...	**19**	**40**	**35**	**2·10**	**1·84**	**2·71**
Zone 7—Average ...	96	156	68	1·62	0·71	1·85
A. G. Pomeroy ...	**20**	**50**	**16**	**2·50**	**0·80**	**2·80**
Irrigation	192	96	...	0·50	.	0·50
R. Hanks	**18**	**23**	...	**1·29**	..	**1·29**
Average All Zones	1,502	1,605	† 931	1·06	† 0·71	1·33

* 3 tons Silage equivalent to 1 ton Hay. † Irrigated Zone omitted.

It will be noticed that the average conservation of fodder ranges from ½ ton per cow to 1.85 tons per cow, and it is also instructive to notice that the highest conservation of fodder is found in areas recently opened up as at Denmark, Margaret River, and Manjimup.

The table also shows that in each zone farmers are found who, in many instances, conserve three times as much fodder per cow as the average for that zone, *and in each case these farmers are among the leaders in their district.*

The average conservation of fodder for all farmers in the competition was 1.33 tons per cow, the reserve being calculated as hay where 1 ton of hay is equivalent to 3 tons silage. It is considered that 2½ tons of conserved fodder as hay is necessary for safety and ample feeding. This quantity may be conserved as 1½ tons hay and 3 tons silage per cow.

It will be noticed that, although nearly all competitors conserve some silage, the quantity conserved is far too small, averaging less than ¾ ton per cow. It is hoped that all farmers will make a strenuous endeavour during the coming season to ensure that larger tonnage of silage is made, especially in view of the ease with which this form of fodder may be conserved in South-West districts.

In the majority of cases, hay had been cut when too mature. This was especially noticeable in the case of cereal hay which should be cut when the plant is in flower. The actual yield per acre in weight is less at this stage, but the quality of the hay is superior and supplies more digestible material than when cut at a later stage.

A 3-ton crop of Meadow Hay, L Pearson, Benger Cut at flowering stage, carted within two days.

In the case of Meadow hay, where this contains a large proportion of Subterranean Clover, the quality was usually good, as farmers have learnt by experience that, unless cut before fully mature, difficulty is found in harvesting. Where, however, a large percentage of grass was present in the material to be cut, this was invariably harvested when too mature.

A well-built 40-ton silage stack. Dr. A. G. Abbott, Eastbrook. Bags of earth held in position by wire threaded through end; centre filled with earth.

BUTTER FAT PRODUCTION.

Butter Fat Production.

The competition has brought out interesting information regarding the butter fat production per acre in various districts, and also the butter fat production per cow under varying conditions.

Table 14 shows the average production of butter fat per acre for the various zones compared with that of the leading competitor in that zone.

TABLE 14.—BUTTER FAT PRODUCTION PER ACRE.

Zone.	Area devoted to Dairying.	Average number of Cows.	Butter Fat per acre.
	acres		lb.
Zone 1—Average	138·9	31·7	53·4
S. F. Russell	121	38	68·3
Zone 2—Average	247·7	43·5	50·4
P. Rose	540	74	34·5
Zone 3—Average	81·5	19	37·9
A. Oldfield	70	23	47·7
Zone 4—Average	96·1	17·6	35·1
H. Noon	90	22	45·9
Zone 5—Average	92·1	17·1	35·5
H. Grumpelt	160	29	42·3
Zone 7—Average	57·1	13·7	45·4
F. C. Smith	50	10	55·5
Average—			
Unirrigated Farms ...	119	23·7	43·0
Irrigated Farms	71·1	27·4	100·3

The butter fat production per acre varies from an average of 35.1 lb. to an average of 53.4 lb. on unirrigated farms, whilst the average return per acre on irrigated farms was 100.3 lbs. butter fat. Individual returns, however, were considerably in excess of this, Mr. S. F. Russell's herd averaging 68.3 lbs. butter fat per acre, while that of Miss Heppingstone on an irrigated farm at Harvey averaged 148 lbs. butter fat per acre. The average yield per acre for all the competitors was 43 lbs. butter fat.

The value of irrigation as a factor in cheapening the cost of production is brought out, provided the cost of irrigated land is not relatively too high in comparison with that of unirrigated land.

Assuming that the competitors on the average are fair representatives of leading farmers in the industry, then as far as production is concerned the relative value of a dry farm as compared with an irrigated farm would be as 43 : 100.

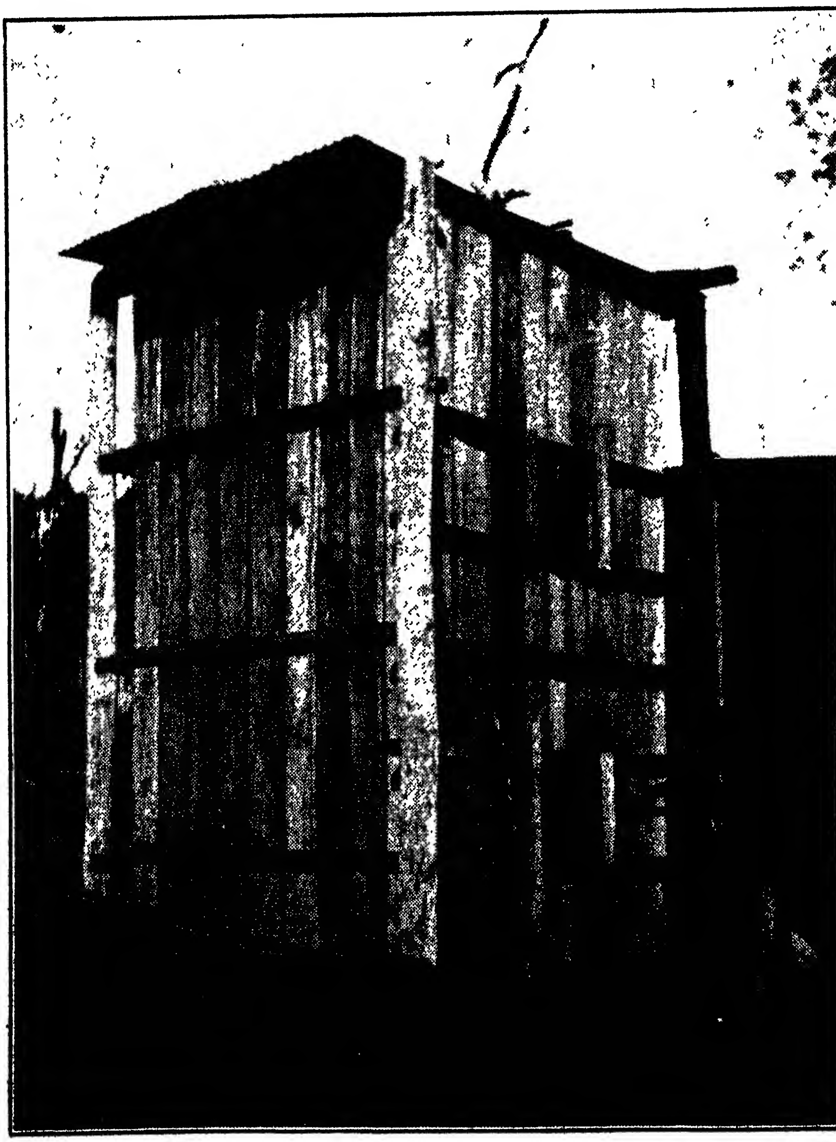
The table also indicates that, on the average, larger returns per acre are obtained where the farm is small and intensely cultivated and managed. This is particularly the case in the newer areas opened up by the Group Settlement Scheme.

Table 14 also shows that the average size of the land devoted to dairying is 119 acres.

The information obtained by the Judges also throws valuable light on the area of land in varying districts necessary for the maintenance of a milch cow. It must be borne in mind, however, that, in addition to the milch cow, this area would support yearling heifers, a bull and the horses necessary to work the farm.

Table 15 shows that on unirrigated areas approximately 5 acres per milch cow are necessary, although in different zones the figures range from 4.2 up to 5.5 acres per cow. On irrigated farms the acres per cow were as low as 2.59.

Assuming that the total capital outlay per cow should not exceed £60, then unirrigated land such as that obtaining on the average dairy farm would be approximately £12 per acre, while the irrigated land would be worth approximately £25 per acre.



A cheap face-cut silo. W. Cox, Jardee. Reduces waste and permits material being chaffed.

TABLE 15—ACRES PER MILKING COW.

Zone.	Average number of Cows in Herd.	Acres in Farm used for Dairying.	Acres per Cow.
1	31·7	138·9	4·38
2	43·5	247·7	5·10
3	19	81·5	4·28
4	17·6	96·1	5·47
5	17·1	92·4	5·43
7	13·7	57·4	4·19
Average — Unirrigated Farms ...	23·7	119·0	4·91
Irrigated Farms ...	27·4	71·1	2·59

The foregoing notes have set out briefly the outstanding points in connection with the Better Dairying Competition inaugurated by the Australian Dairy Council, which may be summarised as follows:—

1. The necessity for planning a dairy farm prior to development, with a view to practising rotational grazing with small fields.
2. The necessity for a more efficient system of book-keeping and records.
3. The type of dairy cow on the farms inspected was good, and owners appreciated the value of breeding for production through the use of a pure-bred bull ex a tested dam.

Feeding Silage. H. C. Barnsby, Clovelly Farm, Pemberton

4. Generally, pig-raising was being practised, but it is necessary to provide for grazing of sows and the feeding of home-grown grain for the topping off of porkers and baconers. The breed of pigs being kept was good.
5. Throughout the South-West, interest in pasture development is general, and efforts are being made to practise control grazing as fast as expenditure on fencing and fertilisers will permit.

6. The pasture at present consists almost entirely of annual species, particularly legumes.
7. Top-dressing with at least 1 cwt. superphosphate is very general. Individual farmers are now experimenting with heavier dressings and with the addition of nitrogenous fertilisers.
8. The cultivation of fodder crops is being neglected. Where no silage is provided, at least ½ acre per cow is recommended; the average area grown was a quarter of this.
9. *Fodder Conservation.*—This is the most neglected factor in profitable dairy farming. The average conserved fodder calculated as hay was 1.33 tons per cow. In order to provide ample fodder during the lean period, 2½ tons are considered necessary, 1½ tons of which should be hay and 3 tons silage.
10. Hay, generally, is cut when too mature.
11. The cultivation of lucerne should be encouraged, failure being due to two main reasons:—
    (a) Non-inoculation of seed with the necessary soil bacteria;
    (b) Sowing during the autumn when the young plants are destroyed by the attacks of the Lucerne Flea and Red Mite.

REPORT ON A SHIPMENT OF LIVE STOCK FROM ENGLAND TO AUSTRALIA WITH SUGGESTIONS FOR REFORM.

H. S. RUDDUCK,
Veterinary Surgeon, Melbourne, Victoria.

The shipment of stock brought out to Australia in the s.s. "Matakana," which left London on 7th January, 1930, arrived at Western Australia 8th February (31 days out), and at Melbourne 17th February (40 days out), comprised 17 head of Guernsey cattle, 18 Southdowns, and 2 head of swine, for which I was personally responsible. The other stock, consisting of Shorthorns, Aberdeen Angus cattle and Tamworth British Black and Berkshire pigs were fed and attended throughout the voyage, under my advice.

Accommodation, Cattle.—Special boxes were provided, made of softwood with boards nailed inside, and two doors—one double (top and bottom) in front and a large single back door. These boxes are lashed to the deck with wire ropes which come right over the top. It is practically impossible to make use of the doors, especially the back one, which is also jammed against the rails of the ship. This door is supposed to be used for cleaning purposes throughout the voyage. One soon realises that the boxes have been designed by people who have no practical knowledge of transport of stock at sea. The wire ropes also interfere with carrying feed and water. As all my stock were quiet, I got over this difficulty by taking the doors off the hinges, leaving a back bar in position, and shortening the head ropes; but it made unnecessary work, because the door had to be lifted off and on each time the boxes were cleaned out, and frequent cleaning out is essential, especially in the Tropics. This defect could be remedied by having a sliding double door--the bottom half need only be moved for cleaning out; but in very hot weather as, for example, in the Red Sea where every bit of ventilation is wanted, the top and bottom sliding doors could be moved across, and two or three bars would prevent the animal from getting out, even if it slipped the halter or came unfastened.

With regard to inside nailing, a good sea striking the box would easily carry the boards away, especially as the timber is green and shrinks in the Tropics. They would be safer if nailed on the outside, and a few pieces inside would protect the stock. The floors are so constructed that there is no provision for drainage. With cows it is bad enough, but with bulls it is a great deal worse, as the urine saturates the bedding from the middle of the box backwards. Not only does this increase the work, but it wastes quite a lot of bedding, and in hot weather, unless the boxes are frequently cleaned, and the animals kept free from manure, etc., caking and soaking into the skin, it results in scalding, lifting the hair, giving a sorry appearance on disembarkation.

The floor should consist of strong timber from 3--4 inches wide with 1 inch spaces between, so that the urine gets away to the deck as quickly as voided. In the Tropics, this floor would not only allow better circulation of air all around the beast even when lying down, but, as hosing with sea water is often necessary, the water would drain off, and the surroundings would be kept more sanitary, with less work.

The wire rope lashing should be adjusted to interfere as little as possible with the work entailed in carrying food and water. There is so much really necessary work with stock on board ship that every detail is important.

Accommodation, Sheep.—The principal defect in the sheep boxes was the floors. They were so constructed that all the droppings and urine accumulated in the straw. Under ordinary temperatures, one could not have a better cause for foot rot, but in the Tropics the trouble is intensified. This accounts for so many sheep landing in Australia being seriously affected with this disease. Sheep should have a batten floor similar to our shearing shed floors. No bedding is required; in fact, they are better without it. The excretions would then fall on to the decks, and the sea hose pipe would clear everything away without trouble. Hardwood battens, 2 x 1, spaced about ¾in. apart, would answer well, and this floor should be about 6in. off the deck.

It is a common practice in Australia to put large numbers of sheep in sheds (shearing sheds). The floors of these sheds, being constructed on similar lines to those recommended in this report, allow the sheep to remain in for an indefinite period without any cleaning out being necessary. It is therefore evident that sheep would travel cleaner, cooler and safer under the conditions advised, instead of in boxes bedded with straw, as at present.

Accommodation, Swine.—The same remarks are again applicable. Floors faulty—no provision for drainage. Not only is work increased, but in hot weather (and pigs suffer a great deal from heat) an open floor would make an appreciable difference. There should be a movable board at each end of the pen for cleaning purposes. Wooden troughs are unsuitable. They are often smashed or eaten beyond repair. Pigs also require two troughs. One should be used for fresh water, the other for food, with a shoot to it from the outside. The iron bars should be made difficult to move, and not be interfered with on the voyage. We were fortunate to land the number we did, as more than one pig got out and did a promenade, generally finishing in or near the cook's galley. One Berkshire pig in particular, whenever he got tired of his quarters, would lift the bars out with his snout and walk around the deck. If the animal had headed straight for the side, it would have been serious for the insurance companies.

Diet, Cattle and Sheep.—The usual scale of food was adhered to when ordering, viz., hay 15lb., chaff 2lb., crushed oats 2lb., linseed cake 3lb., bran 3lb.; and for sheep the same, but smaller, quantities. When considering the diet, it should be remembered that the change of temperature and climate is extreme in a very short space of time. For example, an animal leaving England in December is leaving practically in mid-winter, with all its winter coat on—plenty of fat inside and out. In less than three weeks it is subjected to a climate as regards temperature and humidity, that is a great deal worse and more trying than any mid-summer day in England. For example, 20 days after leaving London the sea water temperature was 84 degrees, and the only breeze was that made by the movement of the ship. If a following wind is experienced, it of course intensifies the conditions. In must be remembered that the animals are confined to a narrow box, with a minimum of ventilation. The heat is steamy and the atmosphere breathless. These conditions demand the most careful feeding, and what is there safer or better for stock leaving England than good English meadow hay? Even if the animals are sent via the Cape instead of the Suez Canal, the ship has to go through the Tropics, which means extremes of conditions, although probably not so severe as through the Red Sea. Consequently, if animals are fed with a liberal supply of concentrates, or with food that is liable to give trouble to the digestive organs, the blood becomes surcharged with effete poisonous materials. A strain is put on all excretory organs; probably the central nervous system becomes deranged, resulting in acute congestion of the lungs, which is followed by heart failure and death. As

a matter of fact, it would be extremely easy for a mortality to take place in this way, and the attendant believe he was doing the best for the stock, to land them in what is commonly known as Show condition. It chaff (chopped) is used, it should always be fed dry. Wet feed is a frequent cause of digestive disorders. Linseed cake with oats is quite good food for heavy milkers, but on a sea voyage it is really not necessary, and when given with chaff, results (after a few feeds) in the animals wasting most of the food, searching for the cake. Beef cattle and dairy cattle not milking will travel remarkably well and put on condition for stud work, which is hard condition, on meadow hay by itself. Should any other food be deemed necessary, a few pounds daily of crushed dry oats could be given. In this shipment we had a very fine five-year old Shorthorn bull. He was an enormous animal and in Show condition when shipped. Many English experts said we would not only experience trouble with him in the Red Sea, but they did not think he would ever arrive at his destination. To commence with, the attendant of the beef cattle damped the feed, which contained bran, oats, cake and chaff. After a few days, at my request, he was fed dry, and before entering the Red Sea, when the weather commenced to warm up, at my request again, he was fed almost entirely on meadow hay with a small quantity of crushed oats and bran dry.

This animal, in the Red Sea, certainly was hosed several times daily. His joints, on account of his weight, and the rolling of the ship, began to trouble him, until the hosing was commenced, and I am quite certain that even then if he had had the usual feed, it would have been a very serious matter for him, but with the diet he was on, and the liberal use of sea-water, he really did not give us an anxious time at all, and landed in splendid condition, with perfectly clean legs.

Feeding Horses.—Horses should be fed on chaff, crushed oats, and bran, given in a dry condition, and a liberal supply of hay at night. They should have water three times daily before feeding. There were no horses in this shipment, but I have had considerable experience with shipping army horses to South Africa and Egypt, and, on the diet, never had a case of digestive trouble, Colic or Founder, and the horses arrived in good, hard condition.

Feeding Sheep.—The sheep throughout the voyage, were fed entirely on meadow hay and roots. I had some excellent kohl rabbi which lasted until we reached Western Australia. Only a small allowance of roots once daily; but the hay racks were never empty, and the sheep seemed to be eating or cudding about 20 hours out of 24. If roots are sent, the attendant should have a root-cutting machine. The risk of an animal being choked by hand-cut roots is thereby obviated. Also, arrangements should be made with the chief officer for stowing them where they will keep best. All the ewes I brought out were heavy in lamb. They not only landed in good order (two died from the heat, lambing troubles), but since landing the ewes and lambs born *en route* and after arrival have all done extremely well, showing that the diet which was safe was also sufficient.

If used without waste, 4 lb. daily of meadow hay should be sufficient for each sheep.

Feeding Swine.—On every ship there is a good deal of waste food that makes excellent pig food, consequently arrangements should be made for a supply of this, along with the usual food shipped, such as barley, meal, pollard, etc. Only it is essential to inform the cooks that no salt or soda is to get in from the galley, as the result would be fatal.

Hay Nets.—Hay nets should be provided for all stock, not only for purposes of economy (the nets could be filled where the hay is stored and carried to the

stock without loss from wind and rolling), but there is the additional advantage that an animal is not likely to over-eat on hay; therefore, when the captain makes his daily inspection, if there is a good supply of hay in the nets and water in front of the stock and the stalls, etc., are clean, he will know that the animals are getting all the essentials attended to.

With ordinary hay racks for sheep there is a lot of waste, both in carrying hay to them along the decks, and by the sheep when feeding. This could be avoided by hay nets.

Water.—It is most necessary and important that cattle, sheep, and swine should have water in front of them during the entire voyage. In the Red Sea, the S.D. ewes drank over two quarts each daily. The swine also took it freely, and an abundant supply with frequent hosings of sea-water no doubt largely accounted for no mortality with them.

Re Rock Salt, Blood Salts, Treacle, etc.—None of these is necessary. The addition of a little sea-water (which contains a perfect solution of blood salts) to the drinking water is far better than either of the former. As a matter of fact, rock salt is hardly ever touched by stock on the voyage. Treacle is useless, as no wet food is used. It is a good food for cold weather, but not for the Tropics.

Medicines.—A good skin-dressing, easily applied, is essential, as ring worm and skin chafe are common. Liquid paraffin (medicinal) is preferred to linseed oil, and a few fever drenches, laxative drenches, scour or diarrhoea mixtures, eye lotion, wound powder, antiseptic ointment, a pound or two of cotton wool, bandages, and a bottle of veterinary iodine will complete the requirements. As a matter of fact, with careful feeding and ample water, very little medicine is necessary.

Lambing Ewes.—Several of the ewes lambed on the voyage—a great deal of trouble was experienced. In the first place, all the ewes were very fat. Several had won prizes and were shipped in their Show form. They felt the heat in the Red Sea (two out of eighteen in lamb succumbed). In addition, most of them had twin lambs. Not one lambed with a normal presentation or without assistance. This may have been due to loss of tone in the uterus and abdominal muscles from the heat, etc., with the young getting misplaced in their movements. Anyway, the lambs appeared at birth with a mix-up of legs and sometimes heads, and seemed very weak for a few days. Teaching them to drink required not only a lot of patience, but some manoeuvring, as it took some time to get their sea legs and accommodate the suckle to the roll of the ship. I have had calving cases on board ship and think nothing of them, but the lambing of ewes under voyage conditions should be avoided if possible.

Rugging.—I believe that horses, cattle, and sheep would travel in greater comfort, and with less risk, if they were clipped and rugged prior to embarkation. If necessary, a blanket could be used for horses and cattle, as well as a canvas rug. A rug only, or even a good piece of hessian bag, would be sufficient for the sheep. As the ship ran into the Tropics the clothing could be removed, and put on again if necessary if the weather got colder further south.

Stud Work.—It is quite common experience for an importer of stud stock, to have trouble with the animals imported in regard to their capabilities at stud. I have often been called in professionally to attend horses, cattle, sheep and swine on account of their inability to perform their work, and almost without exception their condition can be attributed to wrong feeding on the voyage. Taking the

experience of this particular shipment, every animal, so far as we are aware, has landed in vigorous condition, and some of them have gone straight to stud work without any acclimatisation at all. For example, one Southdown ram, as soon as released from quarantine, was mated with 100 stud ewes, and did his work successfully. This "condition" is described as hard condition, and must be distinguished from what is known as Show condition, or, in other words, fat. There is nothing more detrimental for stud work than landing animals in Show condition.

Summary.—I do not think it is generally known that all boxes carrying live-stock to Australia are prevented from landing, but have to be broken up and dumped at sea. This is surely waste. On the s.s. "Matakana" there was an ideal place for carrying stock in the shelter deck. It could have been fitted with the minimum expense. All that would be necessary for sheep is a false floor as already described, laid on the deck in sections. Ordinary sheep hurdles, to which English sheep are accustomed, would keep them in their respective quarters without trouble. Cattle would, of course, necessitate stronger partitions and fronts; but, even so, the actual outlay would be considerably less than the cost of the boxes used at present. Moreover, the greater part of timber used would probably be useful afterwards as ship's timber, and the false floors would not occupy much room if stored for further use, provided the trade warranted it. Some of the ships are even better suited for this plan than the "Matakana," having a good supply of portholes in the shelter deck, so that, with the openings fore and aft, as well as portholes and hurdles between the sheep, openings in the partitions between cattle, together with batten floor off the deck, there would always be a current of air circulating, which could be reduced if necessary.

Costs.—It is reasonable to assume that if these suggestions were acted on there should be an appreciable reduction in the expenses of shipping live stock, and possibly, ere long, in insurance expenses also, as the stock would be carried with a minimum of risk.

In the reduction of expenses there is not only the lessened cost of the simple food and quantities recommended, as also straw bedding (for sheep no bedding is required, and for cattle half of that now supplied would be ample), but a considerable saving would be effected by the lessened cost for cartage, railway charges, dock dues, handling, and many other miscellaneous charges, as well as in the amount of space occupied on board, which probably makes part of the shipping charge.

Further, the cost of bags for foodstuffs in the quantities now shipped, is a considerable item. New bags have to be used—second-hand bags not being allowed on account of the foot and mouth disease. As an instance, bags purchased for my stock cost £27 wholesale. As instancing the waste involved in providing fodder for the voyage in the quantities at present considered necessary, it might be mentioned that I had over 160 bags of chaff untouched. As under the quarantine laws, no foodstuffs can be landed in Australia, the whole of the excess fodders were taken to sea and dumped overboard. The space occupied by the excess fodder must also be regarded as an unnecessary item in the cost, and altogether my experience was such that I felt it incumbent upon me, in the interests of importers of stock, to set out the facts in connection with my experiences so that they might be brought under the notice of those who might be in a position to have alterations made with future shipments.

CHANNEL ISLAND CATTLE—JERSEYS AND GUERNSEYS.

It is not generally recognised, even by the powers that be, that these cattle when on their native soil, are amongst the soundest and the healthiest in the world. For example, I was informed by the veterinary authorities in both Jersey and Guernsey that tuberculosis was practically unknown; that contagious abortion was absolutely unknown; that warbles had never been seen; and that all the Channel Islands were free from foot and mouth disease. They have one disease—Johnne's disease—which gives a certain amount of trouble, and for this a diagnostic agent has been found by Major Dunkin, M.R.C.V.S., the person who has world-wide reputation for work done on canine distemper, in association with Doctor Laidlaw, at the Medical Research Laboratories, Mill Hill, London. This fact is worthy of consideration and would possibly be of more benefit to Australia than the tuberculin test which is now applied twice on cattle practically free from tuberculosis. Please note that these remarks apply to cattle in the Channel Islands, and not to Channel Island stock in England, irrespective of where they are born.

These interesting facts open up some very big questions for Australia. For example, on account of warble fly we are prevented from importing Channel Island stock for every six months out of twelve. Yet the Channel Islands, as already stated, are free from warbles.

Again, although the Islands at present are free from foot and mouth disease, the cattle are quarantined in England, and examined every day by the veterinary officer of the Board of Agriculture and Fisheries, to see if they are free from foot and mouth disease. The risk of infection is from the stock in quarantine, as they are landed in England under special supervision and not allowed to come in contact with any other stock. They travel in specially disinfected conveyances.

Surely it is reasonable to ask that if the cattle landed in England under the supervision of our own veterinary surgeon were conveyed under the same supervision, straight to the ship, that would be sufficient to meet all the requirements and, if so, why, as the Islands are free from warbles, should they not be shifted any time during the year?

If the objection of bad weather is raised, interfering with the delivery of cattle to time, arrangements could be made for the cattle to be on board say 48 hours before sailing from England.

This fact has more than one effect. Firstly, the expenses are increased. Inspections, maintenance, extra freights, and quarantine fees on 11 head of Guernsey cattle amounted to over £84. The whole of this could have been saved if the stock had gone straight to the boat, the same practically as the Channel Island stock do going to America. Secondly, the accommodation in quarantine, which is limited, is taken up unnecessarily and so prevents other stock urgently required from going in. For example, one of my clients cabled from Australia requesting me to purchase Southdown sheep. On account of all space being taken in the quarantine station I was prevented from buying. Unfortunately the order has not yet been filled.

With regard to expenses, many people have the idea that importing stock is a rich man's hobby and that costs do not count. This is a very serious error of judgment. Quite a number would import and go short themselves for a long time if all costs were cut down to a minimum, and there is no doubt that small

men financially importing will give greater personal attention to stock, and that in a very short time Australia would benefit and, in turn again, the Empire also.

This no doubt was what originated the Empire Marketing Scheme for which I and others are truly grateful, and I venture to say that if the scheme is carried on for a few years there will be a great outlet for the stud breeders at Home—a great gain in better stock at this end and ultimately more suitable products for the markets at Home and abroad.

It is with the object of assisting, possibly in a very small way towards this end, that I have subscribed these notes, and if I can help directly or indirectly in the future with this work I shall be pleased to do so.

ESTIMATED SAVING IN COSTS IN THE DIFFERENT METHODS OF FEEDING, ETC.

The ships average about 31 days out from London to W.A. (where supplies can, if necessary, be obtained) and are about 10 days on the Australian coast before reaching Melbourne, therefore 40 days' allowance should be sufficient.

Cattle, say 25lb. meadow hay daily x 40 days (or say ½ ton per adult head)—1,000lb.

Sheep, say 4lb. meadow hay daily x 40 days—160lb.

Cattle—2 bulls, 11 heifers, say 6½ tons; 2 yearling heifers, 2 calves, say 1 ton; 18 sheep, say 1½ tons. Total 9 tons.

	£	s.	d.
9 tons meadow hay at £6 10s. per ton	58	10	0
1 ton crushed oats	10	0	0
Allow for new bags, trucking and various expenses say ..	12	10	0
5 cwt. straw for 15 head, say 5 tons at £2 5s. per ton	11	5	0
	£92	5	0

No straw required for sheep and half that now allowed for cattle would be ample. No roots in this estimate. One ton used on voyage.

The fodder and straw for the animals on the "Matakana" cost £191 12s. 6d., so that I estimate a considerable saving could have been effected; but, as already stated, over 160 bags of chaff, surplus hay and straw, etc., were not allowed to land. Therefore, less space for fodder would be wanted on the voyage, and if other accommodation than the boxes referred to could be provided (which are dumped), it is possible that further economies could be effected.

Had the stock (11 head of Guernsey) gone straight to the boat instead of into quarantine a further saving of £84 would have been effected.

PRODUCERS' MARKETS CO-OPERATIVE, LIMITED,

QUARTERLY REPORT ENDING 30th MAY, 1932.

Fruit.

Apple supplies during the quarter were heavy, prime lines being in good demand, but inferior fruit sold at low values. New Season Navels sold at steady values, and values for Lemons firmed towards the end of the quarter. Mandarins of good quality firm and good variety. Pears in demand.

Vegetables.

Heavy supplies of all lines of vegetables were forward during the quarter. Potatoes were in steady demand and values were firmer than the corresponding period for some years. Pumpkin values were consistently low and inferior quality was hard to quit. Swedes were not so plentiful and a steady demand existed for prime lines. Cabbage was short during March and values were then good, but later supplies increased and values receded. Beans were glutted during the whole time and values were below a paying price. Peas were moderately supplied to a steady market, with values good. Sweet Potatoes were about equal to the demand. Cauliflowers started early in the period and supplies were heavy from jump; values were easy for prime lines, and inferior lines at glut level. This had a weakening effect on other lines, principally Cabbage and Beans. Rhubarb heavily supplied and values low. Celery also heavily supplied and the demand was weak, even prime lines being hard to quit at satisfactory prices. Bunch lines consistently heavy throughout with values only fair. Lettuce maintained a steady price and special lines were high.

Eggs.

During the quarter under review egg supplies were considerably decreased in quantity. Values were not so high this year as last, due to Cool Store eggs being in demand, and to the effects of the depression. It has been noticeable that once the eggs realised over 2s. the consumption eased. On the average eggs have been firm at prices ranging from 1s. 9d. to 1s. 11d. for metropolitan new laid.

Poultry.

During the quarter under review supplies have been heavier, with all lines well supplied. Cockerels and Black Hens have sold at satisfactory values. Muscovy Ducks and Drakes over-supplied were hard to quit even at low values. Turkey Hens and Gobblers heavily supplied towards the end of the quarter, but the quality offering was not up to the requirements of the trade.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF MARCH, APRIL AND MAY, 1932.

—	March.					April.				May.			
	2nd.	9th.	16th.	23rd.	30th.	6th.	13th.	20th.	27th.	4th.	11th.	18th.	25th.
Sheep	10,586	8,391	8,298	9,564	7,875	9,550	11,585	10,657	8,297	8,392	10,699	11,298	10,144
Cattle	535	500	564	605	487	582	615	546	580	530	482	467	503
Pigs	1,633	1,455	1,441	1,412	1,555	1,691	1,397	1,656	1,286	1,459	1,381	1,500	1,621

COMPARATIVE VALUES PER POUND.

—	March.					April.				May.			
	2nd.	9th.	16th.	23rd	30th.	6th.	13th.	20th.	27th.	4th.	11th.	18th.	25th.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d	d
Mutton ...	3½	3½	3½	3½	4	4	4	4	4¼	4¾	4½	3¾	3¼
Beef	4½	4½	4¼	4¼	4¼	4¼	4½	4	4	4	5¼	5¾	6
Pork	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½
Bacon	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5	5

MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding the chaff available for auction at the Perth Railway Yards, for the period March to May, inclusive:—

——	Quantity (figures include all qualities of Wheaten and Oaten Chaff).	Minimum Price f.a.q. to Prime Wheaten.	Maximum Price f.a.q. to Prime Wheaten.
	tons.	£ s. d.	£ s. d.
March, 1932 ...	985	4 5 0	4 12 6
April "	1,220	4 5 0	4 15 0
May "	785	4 12 6	4 17 6

It will be seen from the figures quoted above that the market has had a firming tendency. This result, however, has to a large extent been caused by the fact that a very considerable proportion of the chaff offered for sale at auction apparently has not reached owners' ideas of value, and has been stored in Perth and Fremantle. Such action, of course, has had the effect of temporarily firming the market, but the position cannot be considered a healthy one and the methods adopted may result in lower prices as the stored chaff is put into consumption. Our considered opinion is that farmers holding supplies should lose no time in marketing.

Oaten Chaff:—There is a fair inquiry for oaten chaff of all qualities. Prime was selling in March at from £4 5s. to £4 10s., in April at the same figures, and in May at £4 10s. to £4 12s. 6d. per ton; f.a.q. at about 5s. per ton lower.

Oats:—During the period under review supplies have been far from plentiful, and with a good inquiry the market has remained firm, good heavy feeds selling at from 2s. 1d. to 2s. 4½d.; good feeds at from 1s. 8d. to 2s. per bushel.

Wheat:—In March, f.a.q. sold as high as 3s. 6d. per bushel. In the same month second grade realised up to 3s. 4d. In April the maximum price for f.a.q. was 3s. 4½d., the same having been secured in May.

We have a very good inquiry for all produce lines mentioned above, and farmers consigning to us for sale at auction can be assured of securing the highest market rates.

METEOROLOGICAL INFORMATION.

Stations.	March: Temperature, Maximum, Mean.	March: Temperature, Maximum, Highest.	March: Temperature, Minimum, Mean.	March: Temperature, Minimum, Lowest.	March: Rainfall, For Month.	March: Rainfall, Average.	April: Temperature, Maximum, Mean.	April: Temperature, Maximum, Highest.	April: Temperature, Minimum, Mean.	April: Temperature, Minimum, Lowest.	April: Rainfall, For Month.	April: Rainfall, Average.	May: Temperature, Maximum, Mean.	May: Temperature, Maximum, Highest.	May: Temperature, Minimum, Mean.	May: Temperature, Minimum, Lowest.	May: Rainfall, For Month.	May: Rainfall, Average.
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	90·0	104·3	62·4	54·5	0·61	0·63	80·8	91·3	57·5	50·3	1·13	0·45	...	...	...	...	...	2·43
Geraldton	83·8	98·0	63·7	50·4	1·65	0·45	79·2	90·0	61·8	53·0	1·01	0·82	76·1	88·0	59·7	50·0	2·12	2·82
Walebing	84·9	103·0	57·6	50·0	2·14	0·75	...	...	...	...	...	0·80	...	...	...	...	...	2·63
Perth	79·6	96·7	60·7	50·2	0·17	0·78	74·4	87·1	57·2	48·1	3·16	1·68	70·1	83·0	55·0	45·0	8·22	5·07
Kalamunda	79·4	94·5	57·0	46·9	0·36	0·83	71·7	84·9	54·6	47·2	4·15	1·96	66·9	80·0	52·0	45·0	11·06	6·08
Bunbury	75·6	86·0	55·4	47·0	0·98	0·99	72·3	83·0	52·5	40·0	1·38	1·71	68·5	77·5	51·4	43·0	4·38	5·23
Bridgetown	79·0	93·0	48·3	34·8	0·87	1·04	74·1	86·8	46·2	35·0	1·88	1·72	67·7	82·5	44·2	29·8	6·17	4·62
Albany	70·6	83·6	58·0	52·0	1·35	1·54	70·4	82·6	54·1	45·0	1·81	2·77	66·9	83·0	50·9	40·8	4·77	5·01
Merredin State Farm	83·3	95·8	57·1	47·2	0·59	1·04	75·4	87·9	52·7	40·0	0·42	0·84	70·1	81·2	50·7	39·6	1·60	1·34
Northam	85·2	99·0	57·5	47·0	0·28	0·73	77·2	90·4	53·9	44·0	1·80	0·81	71·0	83·0	49·6	40·0	3·92	2·22
York	83·6	97·0	56·1	44·5	0·23	0·63	75·8	88·8	51·7	42·0	1·49	0·81	69·8	81·5	48·2	36·5	4·78	2·31
Narrogin State Farm	79·6	92·1	50·9	39·0	0·84	0·80	71·8	82·4	48·3	40·4	2·10	1·16	66·4	77·6	46·4	37·0	5·41	2·81
Katanning	78·0	92·0	52·2	42·7	0·65	0·96	72·0	84·0	49·3	40·0	1·57	1·18	66·4	80·0	47·1	33·6	4·61	2·36
Cape Leeuwin ...	71·8	86·2	61·4	57·0	0·44	1·22	70·2	83·0	60·9	50·0	2·43	2·25	66·7	80·2	56·6	49·8	8·96	5·77

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

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No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
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The Management of Poultry under Western Australian Conditions, by W. T. Richardson Poultry Adviser.

This is a most useful and valuable book, not only for beginners, but to all those who keep fowls for pleasure and profit. It deals fully with all matters connected with the industry, including Breeding, Feeding (for stock birds or egg production), Incubating, Brooding and Care of Chicks, Marketing (eggs and poultry), and all matters of use to the poultry-keeper. It also fully describes symptoms of various ailments and diseases and simple treatment for same, and, as the book was written to suit *local conditions*, every poultry-keeper should have a copy by him. Price, 2s.

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This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

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This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

JOURNAL

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WESTERN AUSTRALIA.

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A CASE FOR "BULK HANDLING" IN W.A.

GEO. L. SUTTON, Director of Agriculture.*

Wheat is transported from the farm to its destination either loosely or in bags.

"Bulk Handling" is the term given to the method of handling or transporting loose or bulk grain as distinct from handling it in bags. Bulk wheat flows readily and, in consequence, it can be handled entirely by mechanical means and very largely like water; it will run, it can be poured and it can be pumped. The bulk grain is elevated or transported horizontally by power and when elevated its flow by gravity it directed to where desired. In short, the principle underlying "bulk handling" is "up by power and down by gravity."

The machinery used for actually elevating the loose grain is called an "elevator," but by custom this word as now used also refers to the building in which this portion of the plant and contiguous bins are housed, and also includes the additional storage bins, which are sometimes attached. In the latter case the building containing the elevator proper is known as the "Working House." The "elevator" located at the port is called a "Terminal." Because the "elevator" is such a prominent feature of bulk handling the system of handling grain in bulk is also known as the "elevator system."

Bulk wheat is lifted or elevated by two methods—

1. The pneumatic system, and
2. The bucket system.

Pneumatic elevators operate by suction; if the mouth of a tube through which air is being drawn at a sufficiently rapid rate is lowered near the surface of the grain, the latter will be drawn up into the tube and carried along with the air. The illustrations herewith are those of a floating pneumatic elevator located at Bremerhaven, in Germany.† This has a capacity of 75 tons per hour and is erected on an iron punt. The motive power is supplied by the boiler A, and the vertical compound steam engines B, which drive the coupled air pumps C. These exhaust the air through the tube D, from the vacuum chamber E, creating a

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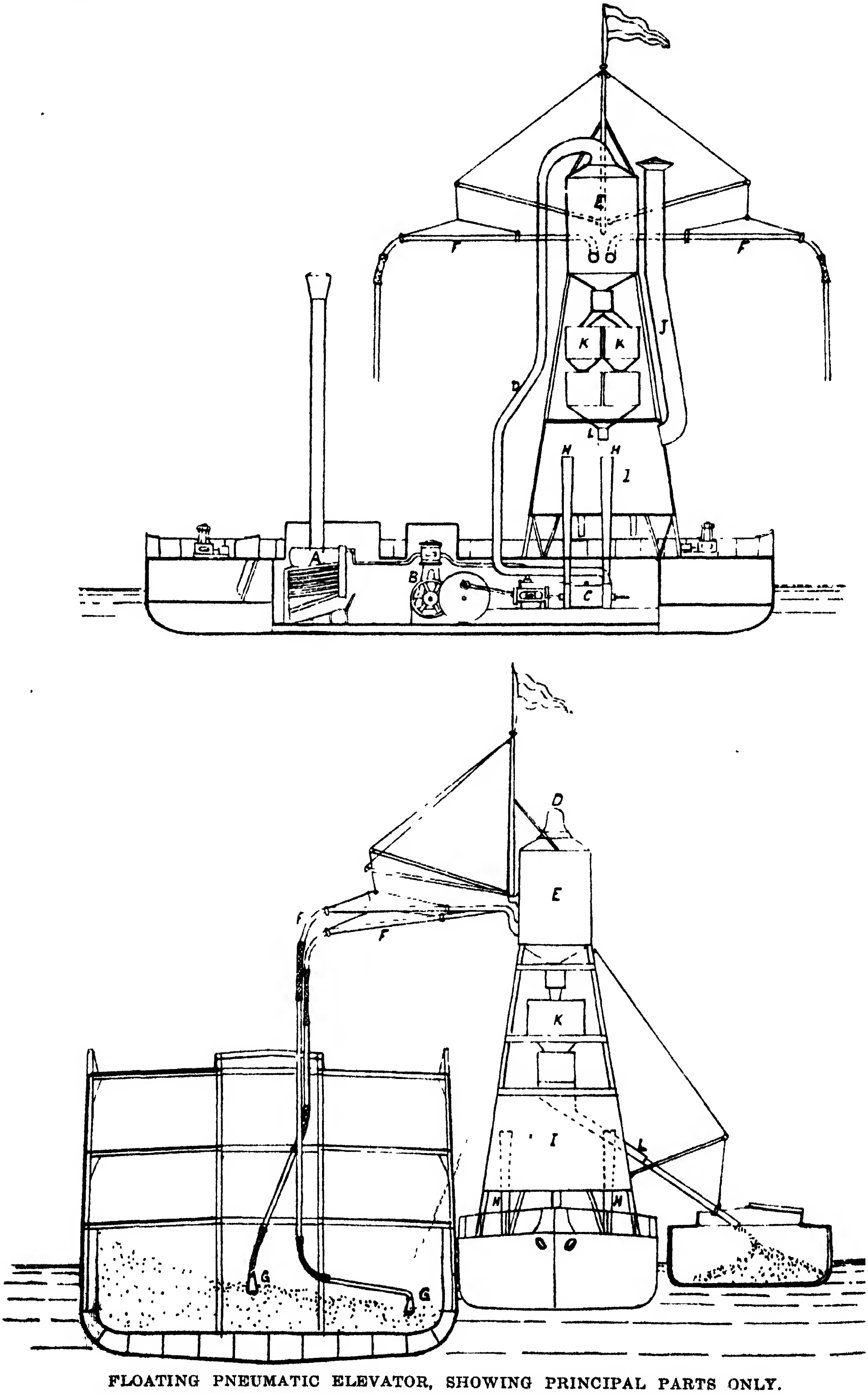
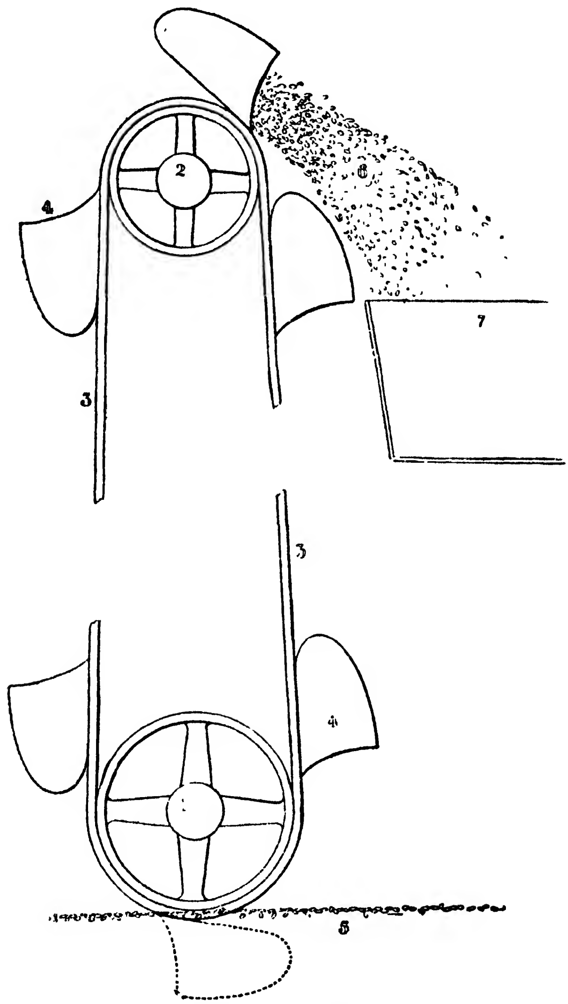
* Paper read before the W.A. Branch of the Economic Society of Australia and New Zealand on 24th June, 1932.

† "The Continental System of Grain Storage," by Oscar Schulze—*Agric. Gaz.*, N.S.W., Dec., 1901.



FLOATING PNEUMATIC ELEVATOR, SHOWING PRINCIPAL PARTS ONLY.
By Oscar Schulze, *N.S.W. Agric. Gazette*, Dec., 1901. *(By courtesy N.S.W. Dept. of Agric.)*

vacuum of about 12 lbs. With this surplus of atmospheric pressure air enters into the flexible suction tubes F through the nossel G, which is inserted into the grain and handled so that the air draws with it a large proportion of grain and deposits it into the vacuum chamber E. freed from dust and husks which are exhausted from chamber E with the air, and after passing through the air pumps and exhaust tubes H, are caught in the dust chamber I, from which they are drawn off at the bottom and bagged or otherwise disposed of, while the dust-free air escapes through the funnel J. From the vacuum chamber the grain passes through alternately acting automatic weighing machines K into the shoot L, which delivers



THE "BUCKET" ELEVATOR

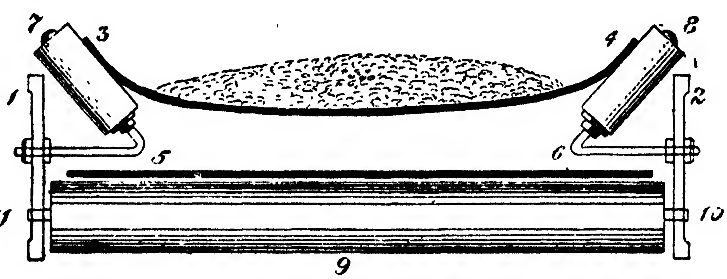
Rough diagram to illustrate the action of an elevator belt The pulleys 1 and 2 carry an endless band, 3, to which are riveted buckets, 4. As the buckets pass round the lower pulley they dip into the grain, 5, and fill themselves. As they pass over the upper pulley they shoot the grain into a trough, 7 The distance from the lower pulley to the upper is over 100 feet in the largest elevators

(By courtesy N.S W Dept. of Agric.)

it either to its destination or, if it has to be lifted again, into another elevator. This system possesses the advantages of speed and greater flexibility than the Bucket system, but it has not been generally adopted, because of its greater initial cost.

The Bucket system is by far the more common. In this system an endless band passes round two pulleys, placed respectively at the bottom and top of the elevating device, technically known as the "elevator leg" or simply "leg." On this endless band "buckets" or "cups" are placed at intervals; as each of these passes around the lower pulley it fills by dipping into the grain contained in a hopper, and after passing round the upper pulley it discharges its load into a receiving hopper or spout. This plan is now very generally adopted in connection with harvesting and thrashing machinery, for instance, when the grain is elevated from the bottom of the winnower to another section of the machinery for bagging or further treatment.

Though loose wheat will flow it will not find its own level as water does; its angle of repose is about 23deg., and, therefore, to ensure that wheat will flow it is necessary that the spout through which the wheat is to flow shall have a greater inclination than this. To provide for this the elevator leg is raised above the tops of the receiving bins and high enough to ensure the necessary slope from the head of the elevator to the bin. It is, therefore, obvious that the number of bins which can be filled from an elevator leg by gravity will be governed by the height of the latter and the distance of the former from it. There are thus limitations to the number of bins which can be filled directly by gravity, and, in consequence, elevators in which all the bins are filled by gravity from the elevator head are confined to comparatively small elevators at country sites.



Cross section of a horizontal grain-belt taken near one of the pairs of oblique rollers used to keep the edges of the belt somewhat raised

1 and 2. sides of the long framework
3, 4. edges of the belt
5, 6. returning portion of belt.
7, 8. oblique rollers for turning up the edge of the belt.
9. roller for support of 5, 6.
10, 11, bearings of the rollers 9

By Dr. N. A. Cobb, *N.S.W. Agric. Gazette*, Dec., 1901

(By courtesy N.S.W. Dept. of Agric.)

When the number of bins to be filled is greater than can be dealt with by gravity from a central "leg," as in large or terminal elevators, the bulk wheat is transferred horizontally by means of a conveyor belt. These belts are usually made of rubber or rubber composition and vary in width from 1 to 3 feet. These run on oblique rollers, one of which is placed on each side of the belt at intervals of 15 to 20 feet, determined by the width of the belt, and which give a concave curvature to the belt. A diagrammatic section of a conveyor belt is illustrated herewith. Whilst they usually run horizontally they will also work satisfactorily on a grade of 1 in 10 if correct speeds are maintained.

The grain is delivered from the spout at the head of the elevator leg on to the centre of the belt, which then transfers it to the bin required, either at the end turning point, when it obviously drops off the belt at it turns downwards over the pulley, or at any intermediate point desired by means of an ingenious zigzag cut-off, as illustrated.

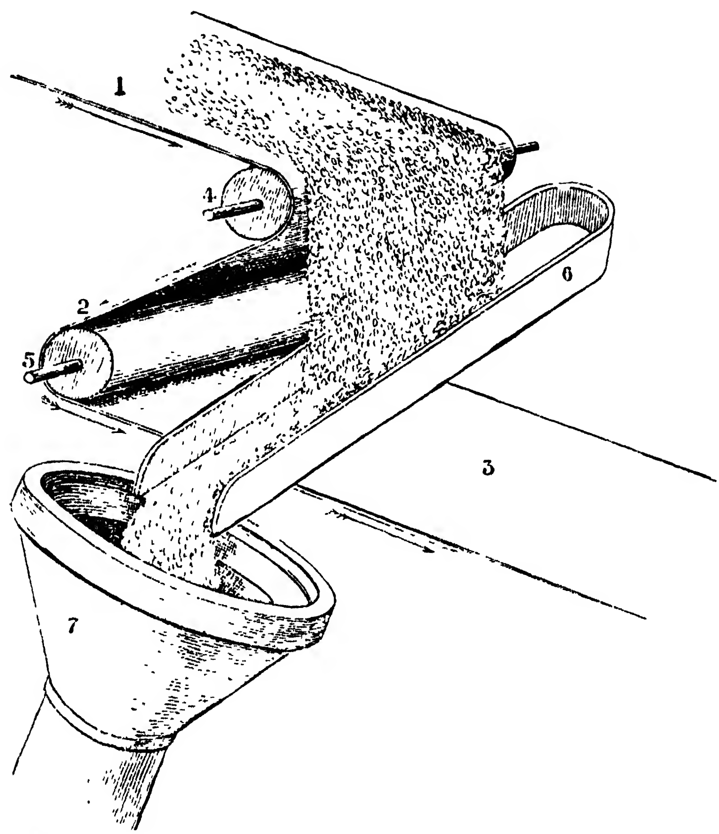


Diagram of a "zigzag." The grain-carrying belt is shown at 1, 2, 3, and the direction of its motion is indicated by arrows. 4 and 5 are pulleys used to zigzag the belt. The grain is shot into a trough, 6, which empties into a spout, 7, leading to a bin or elsewhere.

By Dr. N. A. Cobb, *N.S.W. Agric. Gazette*, Dec., 1901.

(By courtesy N.S.W. Dept. of Agric.)

These belts are very generally used for conveying grain from terminal elevators to the wharf-side for delivery into the ship. They are commonly placed in overhead galleries, and may travel several hundred yards, passing en route over the tops of buildings and making several right-angled turns.

Such then are the simple principles upon which all, even the most elaborate elevators, operating on the "bucket" or "cup" principle are designed. The manner in which they are utilised and applied in individual elevators depends upon the special conditions of the site and the ingenuity and skill of the designer.

"Bulk Handling" is power handling to a much greater extent than is possible with bagged grain. Assuming sufficient grain to justify the system and a capital

cost of installation not in excess of a sum on which the interest and capital fund is not greater than the average annual cost of the containers required under the bag system, the working costs of handling bulk grain must, therefore, be much less than those incurred in connection with handling bagged grain. In times of high or even of reasonable prices the difference may not be of first importance, but in times of low and extremely low prices it becomes a matter of supreme moment, as one of the means whereby the costs of production, including transportation, can be reduced. Hence, in Western Australia, with present prices for wheat now actually below the cost of production, the dormant interest in bulk handling has been revived with great intensity.

Wheat is handled in bulk in other countries to a far greater extent than is generally realised by the average Australian, who is so accustomed to bag handling. Most of the wheat received at our main market, Great Britain, is in bulk. The report issued by the Ministry of Agriculture and Fisheries in 1928 indicated that 85 per cent. of the imports of grain going into Great Britain were in bulk and the only countries shipping in sacks were India, Australia, California, and Chili; fom India all the grain shipped was in sacks, but from Australia, California, and Chili a portion was in bulk.

Except on the Pacific coast, bulk handling is general in the United States of America. On the Pacific coast the conditions are very similar to those which obtain in Australia, and until a few years ago wheat was handled entirely in bags, but a transition from bag to bulk handling is now taking place. A recent investigation into the cost of bulk and bag handling there showed an advantage in favour of bulk handling of 16.4 cents (8.2 pence) per bushel.

In Canada bulk handling is universal, and in 1931 there was storage capacity for 417,000,000 bushels of grain. In the Prairie provinces there were 5,872 bulk-receiving elevators at the country stations; about 800 in Manitoba, 3,250 in Saskatchewan, and 1,800 in Alberta. At the Fort William and Port Arthur terminals there is a storage capacity now for 93,000,000 bushels, having increased in 10 years from 54,000,000 bushels. At Vancouver the elevator facilities have increased steadily and now have storage capacity for 16,000,000 bushels.

Under the bulk handling system the American or Canadian farmer brings his wheat to the country elevator in an ordinary box wagon in the summer or on a sledge during the winter when the roads are ice-bound. The wagon or sledge is driven on to a platform where it is weighed. The receiving platform has a dumping or tilting device, known as the "dump sticks," and the conveyance, after being weighed, is then tilted backwards by these, the slide is pulled out of the slot in the tail-board, and the grain runs into the receiving hopper in a few minutes. From the receiving hopper it is taken by the cups from the boot or bottom of the elevator leg to the head of the elevator and there transferred to the bin to which it is assigned. This is done by means of a turn-head spout at the top of the elevator, which is operated from the floor level of the working house.

In a small elevator the device for diverting the wheat from the elevator hopper may be quite simple and consist of one spout only; in large elevators quite a battery of spouts would be available to take the wheat from the head of the elevator, or from a zigzag on a belt.

En route to the bin the grain may, however, be cleaned and freed from chaff and other unmillable material, or this operation may be delayed until a more convenient time, or even until just prior to the wheat being railed away from the country elevator.

As most country elevators in Canada and the United States are privately owned, it is customary to weigh the wheat as it leaves the elevator, and for this purpose the individual elevators are equipped with weighing machines, the size varying in accordance with the elevators. In large elevators as much as 2,500 bushels would be weighed in one operation, and almost as delicately as a chemist weighs a drug on his balance.

In Canada and the United States, owing to the rigorous winter conditions, covered railway trucks are in general use, and so on being despatched from the elevator the wheat is sent away in bulk in a covered truck, which usually holds from 30 to 40 tons. This is of greater capacity than our open wagons which are so suitable for our climate. The trucks are unloaded into either storage or "primary" elevators, as they are called in Canada, and which are placed on the shores of the lake or into terminal elevators at the ports. From the conveyor belts it is poured, by large spouts, into the ship's hold. As it passes down these chutes it is much easier to take a sample for inspection or record purposes than it is to take it from separate bags under the system which obtains in Western Australia.

As it is impossible for some of the great Atlantic liners to spare the time to go to a terminal elevator, facilities are provided at some ports, as at New York, for punt elevators to take the grain to the liner. These are so designed, however, that when loaded with bulk wheat, this flows to the foot of the elevator; it is lifted by the ordinary bucket or cup conveyor and then transferred to the hold of the liner whose time is so valuable that it is important that every unnecessary delay should be avoided.

Abundant facilities are available in Europe for handling bulk wheat on its arrival there. Most of the main port mills in the United Kingdom and on the Continent have bulk facilities with storage capacity from 100,000 to 1,000,000 bushels. The number that is available, in addition to showing in no uncertain way that ample bulk facilities are available, are remarkable for variety in their designs, but all are modifications of the elevator and grain belt and all are worked mainly on the principle of "Up by power and down by Gravity."

Dr. N. A. Cobb* in 1901 pointed out that even at continental ports, where there were no permanent elevators, bulk cargoes could be unloaded by means of portable appliances and, as a specific case, illustrated in detail, the unloading of a bulk cargo at Antwerp. The cargo was ex the steamer "Friesland," of the Red Star Line; it was one of maize and had to be discharged into canal boats, for various parts of Belgium, into bags for local consumption at Antwerp, and on to the wharf in loose piles to await sale and transportation.

As Canada and America have adopted bulk handling, and apparently with advantage to themselves, it is pertinent to ask "What objections are there to handling wheat in bulk in Australia?" It has been said that, though bulk handling is admirably suited for the conditions which obtain in Canada, yet, because of the different climatic and other conditions obtaining in Western Australia, it is not likely to be suitable there. This, however, is not so. Because of the climatic conditions, combined with difficulties of transportation over inland waterways and over tremendously long distances, the slower and more costly bag handling method is entirely unsuitable for Canada. Had the Canadian farmers been compelled to retain their original bag system it is certain that the development of Canadian lands for wheat production could not have reached its present stage. It does

* "Grain Elevators," Dr N A. Cobb, *Agric Gaz.*, New South Wales, Feb, 1901.

not follow that, because the more favourable Australian conditions have enabled the bag system to persist for so long, the bulk handling system cannot be introduced now with advantage.

Wheat growing in Canada has progressed largely because of the aid it has received from bulk handling; in Australia wheat growing has progressed not because of bag handling, but in spite of it. As has been pointed out by Dr. Cobb in connection with Californian conditions, bag handling is a handicap which our growers have carried by virtue of their flat areas, peculiar climate, and wonderful harvesting machinery.

Since the adoption of bulk handing in Australia was first advocated the objections against its introduction have been many and various. These have been rebutted from time to time and it is significant that, after trial, there is never a suggestion in the country that has adopted it to revert from bulk handling to bag handling. One of the earliest objections was that bulk wheat was unsuitable for transport over the long ocean voyage necessary to reach the European market. To determine this point an experimental bulk shipment was despatched by the White Star Liner "Persic" in 1900. Since then, however, numerous cargoes have been sent to Europe and to the Chinese and Japanese ports just as safely as with bagged wheat, and to-day the insurance on bulk and bagged wheat is the same.

To those unfamiliar with bulk handling it may be thought that parcels of bulk wheat cannot be shipped, but this is disproved by the fact that liners from American-Canadian ports take parcels of bulk wheat, as has also been done by the White Star liners from Australia, though to date this has not been done by the P. & O. and Orient mail boats.

Another one of the objections raised even now to the bulk handling system is that it will limit our markets because it is alleged that the main centres to which our wheat is exported are not equipped with bulk handling facilities. This is not so, for it has already been stated that in our main market, Great Britain, there are abundant facilities for handling bulk wheat.

During the last two years our trade with China and Japan has expanded. In Japan there are facilities for bulk handling at the main ports. In China it is significant that up to the first week of January of the present year (1932) charters had been entered into for the shipment of 2½ million bushels of bulk grain from Sydney to Shanghai.

Whilst those without bulk handling facilities may prefer to have wheat in bags while it is available, yet, if the change is made to bulk, there is no doubt that they will either provide bulk handling facilities at their receiving ports or arrange to bag the wheat on arrival. Even if, however, they refused to do this it would be quite possible to cater for their trade, as the wheat could be bagged at the terminal port before despatch, and this would be perferable to the present arrangement, as it would give our farmers all the advantages of cheaper handling. In addition it would enable the bags to be placed on board in the best possible condition, so that on arrival at their destination their residual value would be greatest. Further, each bag could contain the same definite weight, which reports indicate would be appreciated by the customers.

Dr. Cobb has shown that at Antwerp provision is made for bagging bulk grain at destination for those who desire their supplies in bags. Surely this is more in accordance with the fitness of things that those who require bags should supply them and pay for them. This should especially apply to India, which is an occasional customer for Australian wheat, but has no bulk handling facilities, and where the bags are made from material grown in that country.

Wheat has been handled in bulk in New South Wales since the season 1920/21. It has been claimed that the New South Wales system is an unsound and uneconomic one; that the capital cost has been too great, and that during the past number of years it has been in operation the burden on the taxpayer has been too great to warrant the adoption of the system in other States. This is admitted on all sides, for the capital cost was unnecessarily and abnormally high for present day requirements, and the storage is excessive and not well placed.

It must be recognised that the New South Wales system was initiated during the War period, and largely as a storage scheme in order to prevent the serious losses which were occurring in connection with the stored wheat, because of our inability to dispose of it. In Western Australia a similar but possibly less acute difficulty had to be faced in order to protect the bagged wheat in the compulsory pools from the ravages of insect pests and other vermin; the sheds were enclosed with a less durable material than concrete, but which had to be scrapped at breakdown value on the completion of the storage period, and when the wheat was disposed of. In Western Australia this expense was paid out of the proceeds of the crop which incurred it. In New South Wales it has been debited to the elevator system, and because of this, some deduction from the capital cost, as a handling plant, would seem to be justified.

In examining the New South Wales position it was also found that, when the system was established, the farmers for some reason or other which it is difficult for us to understand refused to use it, for instance, in the first year it was available only 23 per cent. of the available storage capacity was used, and it was not until last year that it was utilised to an extent above its storage capacity. But the position is changed, and now farmers are using it very readily, and in districts where facilities are not available they are even clamouring for facilities to be installed.

It is true that if the possibilities of the New South Wales elevator system be judged by what has happened in the past then there can be no doubt that it has been very unprofitable, but is it reasonable to do so? Is it not more important to judge the soundness and possibilities of the system by what is happening at the present time? This is done in other activities. Do we to-day judge the possibilities of the motor car by what it was capable of 25 to 30 years ago? Do we judge of the possibilities of aviation by the triumphs of the Wright Brothers, or by the admirable record of our own Airways Company? Do we judge the possibilities of wheat production in Western Australia by what was considered possible 20 years ago? The obvious answer to this is "No," and that is the position with the New South Wales system. Is it not rather a triumph for the bulk system, and for its administration and management, that, in New South Wales in 1930/31, the system provided a return of 4⅓ per cent. of the total capital expenditure involved, after making a charge of only 2½d. to the farmers from the farm to the ship, and this despite its admittedly excessive capital, ill-balanced design, and with the utilisation of only 104.18 per cent. of its storage capacity instead of about 130 per cent.

It has been claimed that bulk handling would be handicapped in Australia because of our harvesting methods. The successful operation in New South Wales now definitely proves that this is not so.

Even the advocates of bulk handling were never sanguine enough to imagine that bulk wheat would bring the same price as bagged wheat, as the container of

the latter certainly has some value, but the following letter sent to the Hon. J. Lindsay, Minister for Works, shows that no longer is a premium obtained for bagged as against bulk wheat—

The Farmers' & Graziers' Co-operative Grain
Insurance and Agency Co., Ltd.,

Circular Quay,
Sydney, 2nd June, 1932.

Mr. T. Lindsay,
Minister for Works,
Department of Works and Labour,
Perth, W.A.

Dear Mr. Lindsay,

Whilst the nominal quotation for bagged wheat on the day referred to by you was slightly in excess of that for bulk, I am in a position to inform you most definitely that for quite a period quotations for bulk wheat have been in excess of those for bagged. For example, the estimated f.o.b. price for bagged wheat at one period was around 3s. 5¼d., representing an approximate return to the grower of 2s. 8½d.—on the same day there were buyers for Bulk Wheat Warrants at 3s. 5½d., giving a return of 2s. 9½d. to growers.

This information I feel sure will convince you that, although in the early days of the elevator system in this State, there was a strong prejudice amongst buyers and also growers, of later years, and particularly the last two, the system has become increasingly popular not only with the farmers but with buyers.

We here can sell Bulk Wheat Warrants practically any day, when there are times when we find it extremely difficult to find buyers for bagged wheat.

My opinion is that you should go ahead, if possible, with your elevator scheme, as I feel your farmers will very quickly appreciate the system as much as our growers in this State have done.

Yours faithfully,

(Sgd.) THOMAS B. DONNELLY,

Manager.

The operations of the bulk handling system in New South Wales have shown that the quantity of bagged wheat required for stiffening bulk cargoes is decreasing. At one time it was considered that at least 10 per cent. of the cargo should be in bags. Mr. Harris, the General Manager of the Government Elevators, New South Wales, considers that the average amount of stiffening is about 4 per cent., and that some vessels require no stiffening at all: in 1930/31 there were 8 out of 66 and in 1931/32 2 out of 16 which had none.

The freight on bulk wheat is less than on bagged wheat, the advantage ranging from 2s. 6d. to 3s. 6d. per ton. This is not surprising, for with bagged wheat the ship does not receive payment for the weight of the bags which contain the wheat, but by far the greatest factors influencing the reduction in freight are the harbour charges and overhead capital expenses saved to the ship consequent upon the very much more rapid loading and the reduced expenses for stevedoring. The following instance will illustrate this:—In May last a vessel commenced loading bulk wheat at White Bay, the New South Wales terminal, at 8 a.m.; at 10 p.m. it was completely loaded with 7,500 tons. The same vessel when loaded with bagged wheat at Port Lincoln on a previous trip required 16 days. The time occupied at Port Lincoln was greater than would be

the case at Sydney or Fremantle, where there are very efficient bag-handling appliances, but even at Fremantle the average rate of handling bags may be considered to be 750 tons *per day* compared with 800 tons *per hour* at White Bay, the New South Wales terminal. The amount 750 tons per day is not the maximum with which the facilities at Fremantle are capable of dealing; this is probably twice as much. Nor is the 800 tons per hour the maximum for bulk handling at White Bay; it is 1,200 tons per hour. Broadly, it may be stated that with bulk wheat it is customary to load as much in an hour as in a day with bags.

Even with an efficient bag system a vessel requires almost as many days to load as hours are required under the bulk system. It is believed that, if all the ports in Australia were equipped with bulk handling facilities so that the system became general, the reduction of 2s. 6d. to 3s. 6d. per ton would be increased to at least 5s. per ton.

One of the advantages still claimed for the bag system is that the bag is weighed in as wheat and that the farmer gets paid for it at the same price as the wheat. This is quite true, but just how little advantage this is to the farmer is shown by the following table:—

CASH VALUE OF WHEAT SACKS ($2\frac{1}{4}$LB.) WHEN PAID FOR AT THE SAME RATE AS THE WHEAT THEY CONTAIN.

Price of Wheat.	Value of Sack.	Price of Wheat.	Value of Sack.
	pence.		pence.
1s. 8d.	·75	3s.	1·35
2s.	·90	3s. 4d.	1·50
2s. 4d.	1·05	3s. 8d.	1·65
2s. 8d.	1·20	4s.	1·80

Average price of wheat sacks (10 years)- 9·9 pence.

It is seen that, with wheat at 3s. 4d. per bushel, the West Australian farmer receives 1½d. for a bag which on the average during the past ten years has cost him 9.9d., or a loss, not a gain, of 8.4d. on each bag used.

Seeing that the bulk handling system has proved to be suitable for New South Wales conditions, and advantageous to those farmers who can use it, it is natural to ask, "Can it not be adopted with economic advantage to West Australian conditions?" As the result of the initiation of an experimental system by the Westralian Farmers, Ltd., this can be answered definitely in the affirmative. I desire to make acknowledgment of the splendid public service rendered by the W.A. Wheat Pool and the Westralian Farmers, Ltd., in carrying out this experimental system and so definitely demonstrating that bulk handling can be advantageously applied to West Australian conditions. Scores of farmers served by the sidings of Benjaberring, Korrelocking, Nembudding, Yelbeni and Trayning have proved this to their advantage. Some other farmers who are not normally served by their sidings, and who otherwise would have had to use bags, have realised the advantages of bulk handling and have carted their wheat several extra miles to adjacent sidings in order to take advantage of it. This is in accord with the experience in New South Wales; the Manager of the Farmers' & Graziers' Co-operative Grain Insurance and Agency Co., Ltd., states that farmers travel 12 to 15 miles extra in order to take their wheat to sidings where bulk handling facilities are available so as to take advantage of and benefit by them.

The Westralian Farmers' Ltd. experimental adventure into bulk handling was so successful, and so welcomed by the farmers, that the quantity delivered was much greater than could possibly have been foreseen, and in consequence facilities to receive the wheat had to be provided at short notice. Those handling this matter are to be congratulated on the initiative and ingenuity displayed in meeting the unexpected emergency by the bulk heads storage.

The following *pro forma* balance sheeets relating to the operations of three farmers—Messrs. T. H. Wilson, S. W. Chester, and H. Threlfall—who used the bulk handling system, show just what their savings were:—

COMPARISON BETWEEN BULK AND BAG HANDLING COSTS.

Operations of T. H. Wilson, Esq., Wyalkatchem.

Handled 6,000 bus. in bulk, and 1,400 bus. in bags.

Bulk wheat if sold in bags.	£ s. d.	£ s. d.	*Bulk wheat costs.*	£ s. d.
2,000 bags at 8s. 9d. per dozen	72 18 4		200 bags at 8s. 9d. per dozen ...	7 5 10
Less weight of bags (each 2¼lb. paid for as wheat at, say, 3s. per bus. of 60lbs.)	11 5 0		Special bulk handling charge of ½d. per bus. (6,000 bus.) ...	12 10 0
		61 13 4		£19 15 10
			Less value of 200 bags at half-rate = 4s. 4½d. per dozen ...	3 12 11
Sewing bags (including twine), 2,000 bags at 1½d.		12 10 0		£16 2 11
			Advantage in favour of Bulk Handling	58 0 5
		£74 3 4		£74 3 4
			Per bus., 2·32d.	

Operations of S. W. Chester, Esq., Wyalkatchem (Manager for Hon. J. Lindsay, M.L.A.).

Quantity handled—16,207 bus. in bulk.

Bulk wheat if sold in bags.	£ s. d.	£ s. d.	*Bulk wheat costs.*	£ s. d.
5,330 bags at 9s. per dozen	199 17 6		600 bags at 9s. per dozen ...	22 10 0
Less weight of bags (each 2¼lb. paid for as wheat at, say, 3s. per bus. of 60lb.) ...	30 0 0		Special bulk handling charge of ½d. per bus. (16,207 bus.) ...	33 15 4
				£56 5 4
		169 17 6	Less value 600 bags at half-rate = 4s. 6d. per dozen	11 5 0
Sewing bags (including twine), 5,330 bags at 1½d.		33 6 3		£45 0 4
			Advantage in favour of Bulk Handling	158 3 5
		£203 3 9		£203 3 9
			Per bus., 2·34d.	

OPERATIONS OF H. THRELFALL, ESQ., KORRELOCKING.

Quantity handled, 12,400 bushels.

Bulk wheat if sold in bags.

	£	s.	d.	£	s.	d.
4,128 bags at 9s. 6d. per dozen	163	8	0			
Less weight of bags (each 2¼lb. paid for as wheat at, say, 3s. per bus. of 60lb.)	23	5	6			
				140	2	6
Sewing 4,128 bags at 10s. 6d. per 100 ...	21	13	5			
Twine for 4,128 bags at 1s. 6d. per 100 ...	3	1	11			
				24	15	4
				£164	17	10

Bulk wheat costs.

	£	s.	d.
900 bags at 9s. 6d. per dozen ...	35	12	6
Special bulk handling charge of ½d. per bus. (12,400 bus.) ...	25	16	0
	£61	8	6
Less value 900 bags at half-rate = 4s. 9d. per dozen	17	16	3
	£43	12	3
Advantage in favour of Bulk Handling	121	5	7
	£164	17	10

Per bus.. 2·34d.

The details given for Mr. H. Threlfall's operations are compiled from a letter which he published in the *West Australian* of 22nd January, 1932, but the advantage is not quite the same as stated by Mr. Threlfall. In his letter he debited his operations for the current year with the capital charge of £8, which was the cost of adjusting his waggon to carry bulk wheat, nor did he give credit for the value of some of the second-hand bags which he had purchased for handling his bulk wheat, but which were used at the conclusion of the season for holding oats. In the statement given these items are included.

From these statements it will be seen that the saving ranges from 2.32d. to 2.34d. per bushel. This provides for a special charge of ½d. per bushel in addition to the usual one for bag handling (say 2.772d.), that is a total of about 3¼d. per bushel, which is equal to the charge under the installation proposed by the Westralian Farmers. Is it reasonable to believe that the farmers and others who benefited similarly can be persuaded by any kind of argument that bulk handling is unsuitable for, or unprofitable to, them.

The success of the experimental installation is a solid fact concerning which there can be no argument. It does not follow, however, that its design is that best adapted for general and permanent installation throughout the State. The proposal to instal the design, part of which was eventually installed as an experimental one, was submitted to the Hon. Minister for Works and referred to a Committee, of which the writer of this paper was a member. It was intended by the proposers of the scheme at the time (end of July, 1931) that it should be installed for the 1931-32 harvest, and the Committee was, therefore, asked to report expeditiously upon the proposals. They reported on the 1st August as follows:—"We are satisfied that the scheme is a practicable one, but it has not been possible for the Committee in the limited time at its disposal to say that no better one can be planned"

When it was found that it would not be installed for the current season and more time was available to consider the matter, the same Committee reported on the 1st November as follows:—"We believe that the £1,000,000 would be better applied towards the erection of the more orthodox scheme when money is available."

At the middle of December a sub-committee, of which the writer was again a member, after seeing the experimental scheme in operation, reported as follows: —"Our impressions are that the process suits the farmer and the miller, and that the railways can adapt themselves to it."

The experimental scheme had conclusively demonstrated:—

(a) That bulk handling was suitable for W.A. harvesting conditions;

(b) That bulk handling reduced farmers' costs; and

(c) That the farmers were ready for it.

In this scheme the floors of the bin containers are flat and not hopper-shaped, as is usual with the upright type of container. In consequence it does not provide for as complete mechanical handling of the loose free remaining grain as does the latter. The Committee were therefore convinced that a more complete mechanisation of the handling must result in easier working and greater economy, for cheaper handling charges in perpetuity would more than offset a lower initial capital cost.

The importance and significance of reducing handling costs to the extreme limit is brought out by the fact that a handling cost of 1/10th of a penny per bushel on the handling of 24,000,000 bushels amounts to £10,000 annually, and that this would pay the interest (5 per cent.) and sinking fund (2 per cent.) on concrete silos of the capital value of £143,000. Initial low capital cost is not therefore the main consideration in the installation of a bulk handling system. If it were, then there would be no need to introduce it, for the bag handling system involves *no* initial capital cost, but it does involve a very heavy annual one.

The opinion that it was desirable to have a scheme with a more complete mechanisation of the handling operations than provided in the experimental scheme was confirmed by the author as the result of a visit to the Eastern States as one of the party which accompanied the Hon. J. Lindsay to make personal inquiries regarding the bulk handling of export wheat in New South Wales and of millers' wheat in that State and Victoria. On his return to W.A., the Minister accepted the view expressed by the Committee. With the object of avoiding delay in Parliamentary consideration of this matter, he instructed the Committee to prepare such data as would be necessary to invite designs and tenders, to that definite information regarding costs—not estimates—would be available for Parliament when it met and this subject was brought before it.*

Under these circumstances it became pertinent to ascertain what are the conditions then necessary for the introduction of such a system. Briefly, these are stated to be—

1. Facilities must be provided to receive all the farmers' wheat as under the bag system. Bulk storage on the farm of commercial grain is neither suitable nor profitable;

* Since then there has been so much organised support of the Westralian Farmers' proposal and opposition to any departure from it, that the Hon. Minister has since abandoned the idea, and also a later one to ask for a Royal Commission to investigate the features of different designs.

2. The storage facilities available must be such as to accommodate the wheat likely to be delivered by farmers, less that which the railways can transport to the mills and to the sea-board during the delivery season, and particularly during the peak periods of that season;
3. The terminal capacity must be such as to accommodate, with reasonable limits, the quantity transported by the railways during the delivery period, less the amount which is likely to be shipped during the same period;
4. Farmers must utilise the bulk handling facilities, if provided.

Experience during the past season has demonstrated that West Australian farmers are anxious to have and to use bulk handling facilities.

The table hereunder shows the elevator facilities considered necessary by the special committee appointed by the Hon. J. Lindsay, Minister for Works, in the different railway sections of the wheat districts in the Fremantle Zone:—

ESTIMATED PRODUCTION AND ELEVATOR REQUIREMENTS.

FREMANTLE WHEAT ZONE.

Railway Section	Production		Elevator Units.	Elevator capacity. 1,000 bags.	Surplus.
	As bags. 1,000 bags.	In bulk. 1,000 bags.			
Toodyay	97	354	19	247	107
Eastern Main	37	1,399	69	897	502
Dowerin-Merredin	60	215	58	754	461
Amery, North	12	850	46	598	252
Lake Brown	66	971	57	741	230
Bullfinch-Southern Cross ...	63	63	3	39	24
Dwarda	15	...	...	...	...
Great Southern Main	97	228	9	117	111
Bruce Rock-York	56	698	36	468	230
Corrigin-Merredin	38	545	35	455	90
Narembeen	30	368	21	273	95
Brookton-Corrigin	42	183	9	117	66
Goomalling-Mullewa	...	888	47	611	277
Midland Line		No returns available			
	613	7,762	409	5,317	2,445

The above details have been very carefully prepared by Messrs. J. Hicks (District Surveyor at Northam) and J. H. Railton (District Traffic Superintendent at Northam) after a personal inspection of the localities, consideration of their productivity, and the ability of the Railways to transport the surplus.

Instructions were received to deal with each Zone as served by its respective port. A commencement was made with the Fremantle Zone as being the principal one and in which about 66 per cent. of our export wheat is produced.

The required capacity of the terminal elevator is estimated to be 1,500,000 bushels.

Summarised, the position regarding the transport facilities and proposed elevator storage is set out in the table hereunder:—

SUMMARY SHOWING PRODUCTION AND PROPOSED ELEVATOR FACILITIES.

FREMANTLE ZONE.

	In bags.		In bulk.		Total.	
——	Thousands of bags.	Per cent.	Thousands of bags.	Per cent.	Total, Thousands of bags.	Per cent.
Crop	613	7·3	7,762	92·7	8,375	100
Country elevator capacity ...	...	...	5,317	68·5	...	...
Surplus over silo capacity to be transported during harvesting period, to end of January	...	...	2,445	31·5	...	...
Transported on railways during peak period 10 weeks to end of January, 1930–31 ...	2,886	*37·2	...	...	...	...
Transported on railways during peak period 10 weeks to end of January, 1931–32	2,330	*30·0	...	...	...	...
Terminal elevator capacity ...	...	...	500	6·4	...	...
Deliveries at Fremantle to end of January, 1931 ...	2,793	*36·0	...	...	...	...
Shipments during harvesting period	2,163	*27·9	...	...	...	...
Balance stored	630	*8·1	...	...	...	...
Total elevator capacity ...	...	...	5,817	74·9	...	..

* Percentages of crop to be handled in bulk.

It will be seen from the above summary that the surplus for which no elevator storage is provided amounted to 2,445 bags, and that during the season 1930-31 the Railways transported during the peak delivery period 2,886,000 or 441,000 bags more than required during a normal harvest with storage facilities it is proposed to provide. There would thus appear to be sufficient latitude to provide that all the farmers bulk wheat can be received as delivered and that it will be unnecessary for the farmer to bulk storage on the farm for his marketable grain.

Up to the end of January during the season 1930-31, that of our record harvest, the Fremantle Harbour Trust had delivered to them 2,792,785 bags of wheat. During the same period they had shipped 2,163,307, leaving 629,478 bags in storage. Having regard to the greater rapidity with which ships can be loaded in bulk, when compared with bags, the provision for storage of bulk wheat equivalent to 500,000 bags would appear to be sufficient, and this quantity is that which the Railway Commissioner considers would meet his requirements.

One of the factors influencing the cost of storage facilities required is the size of the unit bin of the country elevator. This is determined by the minimum quantity of wheat considered necessary to justify the erection of elevator facilities at a given locality and the number of commercial types of wheat grown there.

In Western Australia, as in Australia, about 97 per cent. of our wheat conforms to the one standard known as the f.a.q., and therefore there is no necessity under our conditions for the great number of bins which apparently are required under Canadian conditions, much larger and therefore cheaper bins can be utilised.

In this connection Messrs. A. T. Brine & Sons, contractors of this city, have been of great assistance in designing first of all a bin which combines maximum capacity with durability and cheapness, and also grouping these together so as to provide convenient working facilities.

A single bin would, therefore, constitute a unit under the West Australian system, and would be erected at a siding producing 60,000 bushels of wheat, thus providing 66 per cent. storage facilities, the figure indicated by the summary as being necessary to meet the producing and transport requirements. As the producing capacity of the zone served by the siding increased, so one or more units could be added without in any way interfering with the general and completed design, a complete installation consisting of 4 units. If these are grouped in a square we then find that there are inter-spaces, the larger units being used for the f.a.q. wheat and the inter-spaces for the premium or rejected wheat, or for turning purposes.

At sidings requiring less than 4 units it is very doubtful whether provision for premium and rejected wheat is justified, but, if this be so, then smaller bins can be constructed of cribbed timber without in any way affecting the arrangement of the complete design of 4 units, and which, when these 4 units are erected, could be removed and transferred to other pioneer centres.

No provision is made for erecting storage or elevator facilities at sidings producing less than 60,000 bushels. It is considered that the requirements of these sidings can be met by providing loading directly from the farmer's wagon into the truck, as is done in Canada under similar conditions. In 1914 the Canadian Grain Commissioners reported that there were 1,600 sidings at which loading platforms were available, and that the proportion of the crop handled over them was probably one-third of the whole. This large percentage was influenced by the fact that these loading platforms were provided at sidings where elevators were erected, but farmers used the platforms to protect themselves against the practices of the elevator owners.

It is estimated that the requirements as set out in the table already referred to could be provided for by the capital sum of £1,300,000 if the whole of the silos are erected in concrete, or if some of them where similar provision is made are erected of cribbed timber the capital cost would be £1,100,000. Having regard to this, a comparison of handling in bags and in bulk is set out hereunder:—

COMPARATIVE CHARGES IN PENCE PER BUSHEL FOR HANDLING WHEAT IN BAGS AND IN BULK.

Bulk wheat if sold in bags.	d.	d. per bus.	*Bulk wheat costs.*	d. per bus.
Acquiring and handling charges from farmer's wagon to ship, as per Royal Commission		2·772	Interest and Sinking Fund at 7 per cent. on £1,300,000	·950
Extra freight, bagged wheat (2s. 6d. = 3s. 6d. per ton, 37½ bushels at 3s. 1d.)		1·000	Handling from farmer's wagon to ship, as in New South Wales ...	·800
Bags (average cost for 10 years delivered at siding, 9s. 10¾d. per dozen)	3·300		Agent's acquiring charge	·250
Less weight of bag as wheat at 3s. 4d. per bushel	·500		Reserve	·127
		2·800	Bagged wheat required for trimming	·132
Cost of twine and sewing		·500		2·259
			Advantage in favour of Bulk Handling farmer's wagon to ship ...	4·813
		7·072		7·072

The amount used as the charge for acquiring and handling wheat under the bag system is that which was given to the Farmers' Disabilities Royal Commission which inquired into the position of the Wheat Industry in 1931. Since then I understand that there has been a reduction in the price paid to agents, and also in the wages paid to lumpers. Assuming that this deduction amounts to approximately 10 per cent., say, .28 of the cost stated to the Royal Commission, the advantage to the farmer on account of bulk handling is estimated to be 4.53d. per bushel, the saving from the farmer's wagon to the ship's side, and this would be the financial benefit accruing to the farmer who did not require to purchase any sacks as is now the case with Messrs. Wilson and Chester. It is interesting to note that this amount is equivalent to the bonus on wheat paid to wheat farmers this year. The installation of bulk handling would thus be the best means of arranging for a perpetual bonus on wheat, but earned as the result of greater efficiency and not paid for out of loan money which will require to be repaid in the future.

Some farmers will require to purchase sacks as did those farmers who have been cited—Messrs. Wilson, Threlfall, and Chester. Their bag requirements were sufficient to handle 1/10th of the crop, but, as the bags will last at least two years, the ratio of bag requirements to crop is 1/20th. This on the average price of sacks is equivalent to .16 pence per bushel. In such cases it will be necessary to deduct this amount from that already stated reducing it to 4.37d. Other farmers, and these will be the extreme, will require to purchase bags for the whole of their crop, but as these bags will last for at least three years the annual expenditure for this purpose will be equivalent to bags required for 1/3rd of the crop. As the average cost of a bag is 3.3d. per bushel, this will mean a deduction of 1.1d, so that the saving on account of bulk handling to such farmers will be equivalent to 3.43d. per bushel.

The Railway Department has shown that, with the introduction of bulk handling, certain alterations will be necessary in its plant involving considerable capital outlay estimated at £320,000. The annual charge necessary to cover these alterations has been estimated at .50d. per bushel. While there is grave doubt as to whether it is proper to make such a charge against the cost of installing a bulk handling system, for such alterations are the costs which any industry has to pay for progress in that industry, some may consider the deduction should be made. When this deduction is made it will have to be deducted from the figure already given. The farmers in the best position would then benefit to the extent of 3.87d. and those in the worst position at the rate of 3.43d. per bushel.

POSSIBLE DEDUCTIONS FROM THE ADVANTAGE IN FAVOUR OF BULK HANDLING AS SET OUT IN PREVIOUS TABLE.

	d.	d
Advantage in favour of Bulk Handling	4·81	4·81
Less reduced acquiring and handling costs, say, 10 per cent.	·28	·28
	4·53	4·53
Less farmer's costs for bags, as S. W. Chester, say, 5 per cent.	·16	...
	4·37	...
Less costs as in extreme case, bags for whole crop used three years ...	...	1·10
		3·43
Railway alterations ...	·50	·50
	3·87	2·93

In addition to the estimated financial advantage there is also the advantage to be gained as the result of the farmer being able to deal in elevator warrants instead of his actual wheat. These warrants, under a properly designed system, are regarded almost as gold currency and advances can be readily obtained up to something like 80 per cent. of their face value. It is difficult for anyone who has not been in a district where these warrants have been dealt with to realise how great their value is.

Another advantage of a properly designed bulk handling system is that the grain is controlled from the attacks of insect pests and other vermin as well as damage from weather; as may be judged by anyone who has seen the breaking-down of a stack this loss is by no means a light one.

The scheme proposed for Western Australia, whilst showing a substantial benefit to the farmer, provides for all costs to be paid by the industry and involves no burden upon the general taxpayer. In this respect it differs from the New South Wales scheme. In order to see how the proposal discussed compares with the New South Wales system the table hereunder has been prepared:—

BULK HANDLING.

A Comparison of New South Wales Installation and a Proposed Scheme for Western Australia.

Item.	New South Wales.	Western Australia—Fremantle Zone. (Department's Proposals.)
1. Capital Cost	£4,067,240 (at 31-12-31) ...	£1,300,000, all concrete; £1,100,000, composite.
2. Number of Sidings equipped	105	143.
3. Storage capacity of Silos ...	Country 16,613,000 bus. Terminal 6,750,000 " Total 23,363,000 "	Country 15,951,000 bus. Terminal 1,500,000 " Total 17,451,000 "
4. Quantity of wheat to be handled (per season)	24,330,000 bushels (1930-31)	23,000,000 bushels.
5. Elevator capacity	96 per cent	76 per cent.
6. Cost per bushel of total storage	3s. 5·7d.	1s. 6d., concrete; 1s. 3·2d., composite.
7. Cost per bushel of normal crop handled	3s. 4·2d.	1s. 1·6d., concrete; 11·5d., composite.
8. Working Expenses per bushel	0·8d. (1930-31)	Anticipated not greater than in New South Wales.
9. Interest and Sinking Fund, charged per bushel	2·81d. on 24,330,000 bushels at 7 per cent.	·950d., concrete, 7 per cent.; ·863d., composite, 7½ per cent., on 23 million bushels.
10. Charge to Grower, per bushel, through country silo for receiving, handling, and discharging into ship at Terminal	2½d. (1930-31); 2¼d. (1931-32)	Proposed charge, 2d.

It will be seen that the systems are similar only in that both provide for the partial requirements of the respective States. The present Western Australia proposal relates only to the Fremantle Zone; this is because about 66 per cent. of the State yield is produced in the Fremantle Zone, and therefore it was considered desirable that any experience in the installation of the system should be gained

where facilities were greatest. It is, however, the intention, with Parliamentary approval, for the Minister to proceed with the installation of bulk handling in other zones as rapidly as possible. The capital cost of the present W.A. proposal is from 32 to 37 per cent. of that incurred in New South Wales. The proposed storage capacity for Western Australia is only 75 per cent. of that in New South Wales, whilst the crop to be handled in Western Australia is 94 per cent. of that which was handled in New South Wales in 1930-31.

The dominating factor in connection with the economical working is the reduced cost per bushel for the facilities provided. In New South Wales, owing to the special conditions referred to and which obtained at the time the elevators were erected, the cost per bushel capacity for the wheat handled in 1930-31 is 40.2 pence compared with the costs of 13.6 pence for all concrete construction and 11.5 pence for part concrete and part wood and concrete. These differences are consequently reflected in the annual charge necessary to cover the interest and sinking fund to cover them. In New South Wales this will be 2.81 pence per bushel and in Western Australia .950 pence for all concrete construction or .863 pence for the mixed concrete and timber.

In Western Australia the elevator capacity provided is 76 per cent. of the crop handled, and a close investigation indicates that this is sufficient to meet Western Australian requirements. In New South Wales the storage capacity to the crop handled in 1930-31 was 96 per cent This may be reduced as the system is further extended to supplement and balance the original one, and this will naturally have a beneficial effect upon reducing the amount necessary to pay for the facilities provided.

In view of the results obtained in New South Wales and in our own State last year the question with regard to bulk handling is no longer "whether we should have bulk handling," but rather, "what form of bulk handling is the cheapest for Western Australia to adopt?" The figures which have been submitted are from very carefully compiled data and conservative estimates, and it is believed that the actual results will be slightly better than those stated. The intention of the Hon. Minister for Works is, if he can obtain Parliamentary approval, to call for designs, accompanied by firm tenders, so that the most economical design can be selected. In order to decide this question it has been suggested that it is advisable to appoint a Royal Commission or Select Committee to determine whether bulk handling is desirable or not. It is certainly necessary that Parliament should be supplied with sufficient information to enable it to decide this point, but it is difficult to understand what additional information could be made available other than that already collected, and broadcasted by the Hon. Minister for Works, who has been indefatigable in investigating this matter and collecting data from all sources. A Royal Commission or Select Committee has powers to demand information which even a State Minister may not be able to secure, but in this case there has been no need for such powers, for the information desired has been freely and willingly given.

It is, however, believed that when the designs and tenders are received a very careful investigation of the merits of each should be made in order to ensure as far as is humanly possible the very best scheme for Western Australia. It is believed that for this purpose experienced guidance should be obtained, and it is suggested the most suitable for this purpose is the experience which has been obtained under Australian conditions. It is, therefore, suggested that the General Manager and technical officers of the New South Wales elevators are suitable advisers for this purpose.

Whilst the primary object of introducing the Bulk Handling System is to reduce farmers' costs of production, it must not be forgotten that its introduction would involve the expenditure of a large amount of money for labour and materials, much of which is produced in the State and all of which is Australian. This would relieve the pressing need of providing employment on a reproductive work for many who are now without work. On completion of the system the increased spending power of the farmers, estimated at £300,000 for farmers in the Fremantle Zone, will provide additional work and absorb many, if not all, of those temporarily engaged in their construction.

The introduction of bulk handling will undoubtedly do away with the necessity for employing much of the labour now engaged in bag handling. It is unfortunate that this is so, but in this case it is believed that the labour so displaced and more will be absorbed by increased agricultural development and correlated greater activity in other branches of the industry. Expressed in another way, bulk handling will alter the character of the work, but will not reduce, and may increase its volume.

In conclusion the position with regard to Bulk Handling in Western Australia may be thus summarised:—

There are two factors which threaten the stability of our economic life; these are:—

1. Unprofitable prices for agricultural products, and
2. An unprecedented number of unemployed.

The introduction of bulk handling will have a most potent influence in remedying this unsound position. The experience already obtained with the partial installation of bulk handling in a section of the wheat area proved that those farmers who could use it reduced their costs by about 2-1/3rd pence per bushel.

Taking, however, the most extreme and most unfavourable case for bulk handling, this would be where the annual cost for the facilities provided would be equal to the cost of the bag container under the present system, *i.e.*, 3.3 pence per bushel, this annual cost is equivalent to a capital outlay of—

3s. 11.14d. per bushel for concrete elevators, or

3s. 8d. per bushel for wooden elevators.

Even under such almost impossible conditions, provided the capital outlay included the farmer's cost for transport containers, there would still be an economic advantage in favour of bulk handling in that the producer would have the benefit of cheaper handling costs due to the more complete mechanisation of the transport operations.

The work necessary to instal the required bulk handling facilities will provide employment for a large number of men during two or more years, and during a critical period of adjustment and rehabilitation.

The certain reduction in production costs, due to bulk handling, be it small or great, will place the producer on a sounder financial basis, and will, in consequence, increase his spending power and thus provide *permanent* employment for an increased number of men in many avenues of industry.

THE MARKET VALUE OF SUPERPHOSPHATE.

L. J. H. TEAKLE.
Plant Nutrition Officer.

As a result of the century old experiments of Liebig in Germany and of Lawes and Gilbert in England, the use of inorganic phosphate materials, as fertilisers to promote crop growth, has developed enormously throughout the world, and the world's consumption of the raw rock phosphate in 1929 amounted to 10,289,000 tons Europe is the heaviest consumer, France, Germany and Italy alone accounting for 30 per cent. of this huge total. The United States of America is the largest individual consumer, taking about 28 per cent. of the world's production in 1928. (J. A. Bruce, "Commercial Fertilisers and their Basis of Sale," N.Z. Journ. of Agric., Vol. 43, pp. 327-337, 1931.) Australia consumed 617,485½ tons and Western Australia 182,418 tons of raw phosphate in 1928-29.

The rock phosphate is used directly as a fertiliser to a very small extent, the demand in agriculture, particularly in Australia, being for a water soluble and readily available phosphatic fertiliser. On this account the rock phosphate, as mined, is finely ground and treated with an equal weight of sulphuric acid to form the product known as "superphosphate." The phosphate in superphosphate is very largely in the water soluble form and is marketed largely on the basis of its content of water soluble phosphoric acid (P_2O_5).

The amount of phosphoric acid in the superphosphate depends on the quality of the raw materials used. This is reflected by the variety of grades of superphosphate on the market in other parts of the world. The manufactured product resulting from the treatment of the ground rock phosphate with sulphuric acid to render the phosphoric acid soluble in water is superphosphate, whether it contain 13¾ per cent. water soluble phosphoric acid or 20½ per cent. water soluble phosphoric acid (P_2O_5). It consists of a mixture of gypsum, monocalcium phosphate, small amounts of other phosphates, moisture and other substances. It may be mixed legitimately with various fillers such as sand under some circumstances.

Just as the quality of calico, or knife blades, varies according to the raw materials used and the care taken in manufacture, so the quality of superphosphate varies considerably, depending mainly on the quality of the raw rock phosphate used. As with other commodities, such as calico or knife blades, the value of superphosphate depends on the quality, and as the most important constituent of superphosphate is the plant food phosphoric acid, the basis of evaluation is the phosphoric acid content. In South Africa, for instance, superphosphates are classified as follows:—

1. Low grade—less than 15 per cent. phosphoric acid.
2. Medium grade—15.1 to 17 per cent. phosphoric acid.
3. High grade—17.1 to 19 per cent. phosphoric acid.
4. Extra high grade—above 19 per cent. phosphoric acid.

The phosphoric acid to be in a water soluble form.

The superphosphates used in England generally belong to the low or medium grades; in Australia and New Zealand only "extra high grade" superphosphate is

in use at the present time. The purity of the raw rock phosphate obtained from Nauru and Ocean Islands enables our manufacturers to place the "extra high grade" article on the market, thus saving costs in treatment at the factory and in handling in manufacturing, in transport and on the farm. It must be emphasised that "extra high grade" superphosphate can be manufactured in the ordinary way only if extra high grade raw materials are at hand.

The price paid for any line of superphosphate will be governed by the quality of the product, and the quality of superphosphate is gauged by the content of plant food; in this case phosphoric acid. Governments have undertaken supervision of the industry under various "Fertiliser Acts" which compel vendors to guarantee the composition and quality of their products. Inspections are arranged by Government officials to obtain samples for analysis in order that the composition of the lines actually delivered to the consumer may be ascertained. The Acts provide for the prosecution of vendors of fertilisers not conforming to the guaranteed standards.

Unfortunately for the layman, manufacturers and chemists in different countries have adopted different means of expression of the quality of superphosphates. For instance, in most countries the content of phosphoric acid (P_2O_5) is stated. In others, for instance South Australia, the content of tricalcium phosphate is used. Both methods of expression attain the same ends, but not without some measure of confusion. Analogies may be drawn to illustrate the point. If one wishes to drive a motor car from one city to another in Canada, United States of America, or France, one drives on the right-hand side of the road: if in England, or in Australia, one keeps to the left. This difference is very confusing at times, but traffic flows readily under either of the systems when people are used to them. A further analogy may be obtained from the grocer's shop. Suppose two grocers be advertising almonds, extra high grade, and one quotes 3s. per pound and the other 1s. 6d. per pound. At first glance one might think that grocer number one was attempting to profiteer, until it was found out that the grocer who is selling almonds at 1s. 6d. per pound is selling *unshelled* almonds and in consequence they are no cheaper than the shelled almonds which the first grocer is offering at 3s. per pound. A customer would have to buy two pounds of almonds, unshelled, from grocer number two, in order to get the equivalent of one pound of almonds from grocer number one. In the same way, the man who buys tricalcium phosphate buys phosphoric acid with the shells on, and unless he has a little chemical knowledge he does not see the shells, and gets the feeling that he is being robbed by the vendor of "phosphoric acid." This is generally not the case, as calculation to the same basis, for example, phosphoric acid, will show. As 310 lbs. of tricalcium phosphate or "phosphate" contain 142 lbs. of phosphoric acid (P_2O_5), the relation between the two can readily be seen. By means of a simple calculation, by dividing 310 by 142, it is found that, relatively, phosphoric acid (P_2O_5) is 2.184 times as valuable as tricalcium phosphate, or phosphate ($Ca_3(PO_4)_2$). If tricalcium phosphate, or "phosphate," is quoted at 2s. per unit, the value of phosphoric acid (P_2O_5) is 2s. multiplied by 2.184, equals 4s. 5d. per unit. Similarly, if phosphoric acid is quoted at 4s. 5d. per unit, the value of tricalcium phosphate or "phosphate" ($Ca_3(PO_4)_2$) is 4s. 5d. divided by 2.184, equals 2s. per unit.

Of interest is the price actually paid for phosphoric acid in different parts of the world. Prices quoted in various journals and trade papers are tabulated in Table 1.

TABLE I.

MARKET VALUE OF WATER SOLUBLE PHOSPHORIC ACID IN SUPERPHOSPHATE.
(Net Cash Value F.O.R.).

Country.	City.	Date.	Soluble phosphoric Acid.	Unit* Value.	Price per ton.
			%	s. d.	£ s. d.
England	London	6–4–32	16	3 7	2 17 0
	Liverpool	"	16	4 2	3 7 0
	London	"	13¾	3 10	2 12 0
	Liverpool	"	13¾	4 6	3 2 0
	London	15–6–31	16	3 10	3 1 0
	do.	"	13¾	4 0	2 15 0
Victoria	At Works	1932	20·5	4 5	4 10 0†
N.S.W.	do.	"	20·5	4 5	4 10 0†
S.A.	do.	"	20·6	4 5	4 10 0†
W.A.	do.	"	20·5	4 5	4 10 0†

* Calculated from water soluble phosphoric acid content. † The price for terms is £4 15s. per ton.

It should be noted that the Australian 22 per cent. superphosphates contain 0.5 per cent. citrate soluble and 1.0 per cent. acid soluble phosphoric acid in addition to the 20.5 per cent. water soluble phosphoric acid. The amounts of citrate soluble and acid soluble phosphoric acid in the English article is not stated in the journals consulted.

The net cash selling price of extra high grade superphosphate containing 20.5 per cent. water soluble phosphoric acid (P_2O_5), calculated on the basis of the unit value of the 16 per cent. P_2O_5 line, would be £3 14s. per ton in London and £4 5s. per ton in Liverpool. For the purpose of a comparison, the present prices per ton for cash f.o.r. and the unit values of "phosphoric acid" and "tricalcium phosphate" of "extra high grade" superphosphate in England and Australia are set out in Table 2.

TABLE 2.

CASH PRICES OF "EXTRA HIGH GRADE" SUPERPHOSPHATE, 1932.

Prices in London and Liverpool calculated from the Quoted Values of 16% Superphosphate.

Place.	Phosphoric Acid.		Tricalcium Phosphate.		Cost per ton.
	Guaranteed :	Unit Value.	Guaranteed :	Unit Value.	
	%	s. d.	%	s. d.	£ s. d.
London	20·5	3 7	45	1 7¾	3 14 0*
Liverpool	20·5	4 2	45	1 10¼	4 5 0*
Australia	20·5	4 5	45	2 0	4 10 0†

* Pounds sterling. † Pounds Australian.

At the present time, the exchange rate against Australia is approximately £25 per cent.; that is, £100 in England will cost about £125 in Australia. To buy "extra high grade" superphosphate, analysing 20.5 per cent. water soluble phosphoric acid (P_2O_5), in London and Liverpool, on the April quotations, it would cost Australians an extra £25 per cent. to cover the exchange. Neglecting the ocean freights, the costs in Australia would be as set out in Table 3.

TABLE 3.

CALCULATED NET CASH PRICES OF "EXTRA HIGH GRADE" SUPERPHOSPHATE IN LONDON AND LIVERPOOL, APRIL, 1932, IN TERMS OF *POUNDS AUSTRALIAN* IN COMPARISON WITH THE PRICES PAID IN AUSTRALIA.

(*Prices in London and Liverpool calculated from the Quoted Values of* 16% *Superphosphate.*)

Place.	Phosphoric Acid.		Tricalcium Phosphate.		Cost per ton, Australian.
	Guaranteed :	Unit Value, Australian.	Guaranteed :	Unit Value, Australian.	
	%	s. d.	%	s. d.	£ s. d.
London	20·5	4 6	45	2 1	4 12 6
Liverpool	20·5	5 2	45	2 4	5 6 3
Australia	20·5	4 5	45	2 0	4 10 0

From Table 3 it is seen that there is little disparity between the price of superphosphate in London and in Australia in terms of pounds Australian. If anything, on this basis, the price is in favour of Australian farmers. The Liverpool prices are distinctly higher.

As the Australian manufacturers pay exchange only on the raw materials purchased overseas, and not on the cost of manufacture other than raw material, a comparison can be made on this basis. It is calculated that the extra cost due to the rate of exchange of raw materials for the 1931-32 season amounted to 2s. 7d. per ton of superphosphate manufactured; in 1932-33 the extra cost will amount to 4s. 10d. per ton. These amounts must be deducted from the seasonal prices in order to compare them on the 1930-31 basis. Table 4 shows the trend in price of 22 per cent. superphosphate for the years 1927-28 to 1932-33.

TABLE 4.

NET CASH PRICES OF 22 PER CENT. SUPERPHOSPHATE IN WESTERN AUSTRALIA.

Year.	Quoted net cash price per ton.	Net cash price per ton after deducting extra charge due to exchange on raw materials.
	£ s. d.	£ s. d.
1927–28	5 2 6	5 2 6
1928–29	4 16 6	4 16 6
1929–30	4 10 0	4 10 0
1930–31	4 10 0	4 10 0
1931–32	4 10 0	4 7 5
1932–33	4 10 0	4 5 2

From Table 4 it will be seen that the net cash price of 22 per cent. superphosphate in Western Australia has not varied since 1929-30. If the extra cost due to exchange is deducted, the real price of superphosphate has actually decreased by 2s. 7d. per ton in 1931-32 and by 4s. 10d. per ton in 1932-33. Allowing for the extra cost owing to exchange on raw materials, the real cost of 22 per cent. superphosphate for the 1932-33 season is £4 5s. 2d. Australian, which is practically identical with the calculated value (£4 5s. sterling) of a similar grade of superphosphate in Liverpool.

Acknowledgment.

The author is indebted to the Director of Agriculture (Mr. Sutton) for helpful criticisms in the preparation of this paper, and to the Inspector of Fertilisers (Mr. Davenport) for assistance with regard to prices and analyses of the fertilisers.

"PINK EYE" OR OPHTHALMIA IN SHEEP.

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This disease is caused by a germ infection of the outer covering of the eyeball and is seasonable in its occurrence. It appears generally during the summer months and is mostly associated with travelling sheep. The movement of sheep from one place to another facilitates its spread owing to its infectious character. When occurring on farms it causes a loss of condition in sheep but apart from that no other economic loss eventuates. The causal germ is carried from one sheep to another by means of flies, etc.

Symptoms.—The affected sheep will be firstly noticed in their inability to follow the mob. When being driven singly the head is held erect as if the animal is endeavouring to hear in order to discover its direction. When standing quietly the head is held low in order to avoid light. In the early stages of this disease the eye or eyes are noticed discharging water freely. On examination the eye will appear deeply injected or "blood shot." From this the name is derived —"pink eye." The eye will be noticed free from foreign bodies such as grass seeds, etc. The eye gradually becomes worse and the lids become gummy. The eyeball itself becomes opaque at a later stage. It even loses its oval shape and becomes pointed in front. It is at this stage that the animal begins to lose condition, and if affected in both eyes even runs into obstacles or water holes and becomes drowned. The disease gradually spreads to all sheep in close contact, but usually only one eye is affected.

If proper treatment is provided the sheep will gradually recover their eyesight, and spread of the disease to other sheep will be prevented. In this connection it might be as well to remind sheep-owners that it is an offence under the Stock Diseases Act to sell sheep affected with any infectious disease. The only way to avoid "Pink Eye" is to—

(1) refuse to purchase sheep from known infected flocks;

(2) examine fresh purchases and isolate them for a week, or until satisfied that they are free from disease. This is a wise procedure with all fresh purchases of live stock. If the flock is already infected remove the infected sheep into a well-shaded homestead paddock, and hand-feed and water to prevent the serious loss of condition, which will otherwise occur. The eyes of these sheep should be treated daily with the following lotion:—

Sulphate of zinc—10 grains.

Extract Belladonna—10 grains.

Water which has been boiled and allowed to cool—1 pint.

All discharges from the eyes should be removed with cotton wool, before using the eye lotion. The lotion must not be made up overstrength, or permanent damage may be caused to the eye. If unable to get the lotion made up the following lotion may be used instead:—Boracic acid, one teaspoonful, dissolve in a little hot water in a cup. Get a clean beer bottle which has previously been rinsed out with hot water, and fill to neck with warm water which has been previously boiled, then add boracic acid solution. Shake before using. Sheep which are showing an opacity or whiteness of the cornea may be treated with the following lotion:—

Silver nitrate—1 dracham.

Water which has been boiled—1 pint.

A camel hair brush or a fountain pen filler is useful to apply the lotion with, or a clean new oil can.

Every morning early the healthy sheep should be inspected to pick out the fresh cases, and these should be removed to the isolation paddock. As the sheep recover they should be put into another paddock, and not allowed to mix with the healthy sheep until all danger of infection has ceased. The sheep usually recover their sight fully and the infection will disappear in time, but the loss of condition is nearly always severe, and the amount of extra work involved in handling the flock or moving them about is often enormous.

An experiment carried out recently at the Veterinary Laboratory proved that this disease is infectious. Work is also being carried out to find out the causal organism, and if possible, to produce a vaccine which will prevent infection.

DUCK FARMING.

By A. E. Jenyns, Poultry Adviser.

With the growing interest in duck keeping, there are a few facts that intending farmers should understand. It must be remembered that there is a far more limited demand for duck eggs than hen eggs locally, and that, while there is an almost unlimited outlet overseas for the product of the hen, duck eggs are in very small demand in England. These points show that there are limits in duck farming that must not be passed if profitable returns are to be had.

THE LAYING BREEDS.

The main breeds for egg production are the Indian Runner (both fawn and white) and the Khaki-Campbell.

Of the Indian Runners the Fawn is the hardier and least nervous bird, though both Fawn and Whites are splendid layers.

The Khaki-Campbell, a breed which is becoming more popular each season, has the advantage of a larger body and quieter temperament, and is, if anything, hardier than the Runner.

Neither of these breeds of ducks appear to have any advantage over the other as egg layers. They are both, when properly handled, veritable egg machines.

TEMPERAMENT.

In breeding these types of ducks, it is always wise to remember that "haste makes waste," as they will not stand rushing about or rough impatient treatment. If frightened or unduly disturbed, they are liable to immediately retaliate by going into a moult, which means a long period of no eggs and consequently no profit. In duck farming, "temperament" is an even greater factor than with hens. The first thought in going in for ducks should be, "Am I temperamentally suited for handling nervous stock?"

The cause of many a failure can be traced to an impatient, irritable temperament in the farmer himself.

SMALL OUTLAY.

To the beginner the initial cost is very small, as housing is quite a different proposition to poultry. Small dry sheds or camping places for the cold windy seasons are all that are necessary, but for the summer months abundance of shade (natural tree shade is the best) must be provided. This, with clean, cool water, is absolutely essential if the ducks are to be kept in laying condition and health. The runs are low in cost, low fences (2 to 3 feet netting) being all that is needed. An orchard is one of the most suitable places to run ducks. They not only get the benefit of the greens and insects, but in return go a long way toward manuring the trees.

Indian Runner and Khaki-Campbells not being sitters (or non-broody), the farmer has to supply the means of incubation. On small farms a flock of muscovies are kept for this purpose, but on large holdings incubators must be used. In Western Australia it has been found that the best hatching period is from late August to November, as the weather is most suitable and the fertility better.

FEEDING FOR PROFIT.

There is a great difference between feeding and feeding for profit. Some farmers just feed anything, anyhow, and wonder why their neighbour is doing well while they are going out of business. Ducks are susceptible to sudden likes and dislikes in their feeding. The farmer will notice on feeding in the morning that, for some unknown reason, his birds won't eat; they don't like it, and unlike hens they cannot be starved into eating what they do not like. This does not necessarily mean that anything is lacking or wrong with the mixture, but often it is just that the mash is too much the same. Try making it slightly more wet or, if wet, drier, and the ducks will go back to it readily.

With correct feeding and clean water, duck eggs can be given a flavour and appearance equal to hen eggs.

Scale—by measure.—2 parts pollard, 1 bran, 3 chaffed green stuff for morning mash, mixed just damp enough to assure there is no dry pollard. By mixing it in that way it will not sour, and this enables a greater quantity to be fed at one time than the birds will eat up at once—a thing that is quite necessary where birds are

fed only twice daily. The quantity is about right if it is all cleaned up in about two hours. If there is any left at evening feed time, they are getting too much. The same applies to the evening meal, with the exception that the bran is cut out and oilcake substituted, $1\frac{1}{2}$ to 2 lbs. of oilcake to 100 birds. Soak the oilcake in the quantity of water you require to mix the mash. By doing this of a morning, it is ready and well dissolved by evening. $2\frac{1}{2}$ per cent. bonemeal should be added to either meal every other day, and $2\frac{1}{2}$ per cent. meatmeal to breeding ducks only.

Shell grit should be always before the birds, and regular feeding is essential. Almost any kind of succulent greenstuff is good, but it is well to remember that ducks are very shy of a change, and if they are on one particular greenfeed for a long time, they do not take kindly to a sudden adoption of a new green feed. It is a good plan, where possible, to feed different greenstuff as often as possible. If this is done from the start, it makes things better and surer when they come on to lay. Laying ducks should not be let run in swamps or where they can feed on frogs, etc., as this makes the eggs not only dark in colour but coarse in flavour. Correct and clean feeding and watering is the only way to produce a well-flavoured article.

CLARIFICATION OF MUDDY WATER.

By E. S. Simpson.

Recently we received a letter from a subscriber (Mr. Daniel O'Connell, of Jandakot) supplying an excellent recipe for the clarification of some of our coastal waters. We are indebted to this gentleman for the interest he has taken in this matter, which is of more than a little importance, especially in the wheat belt, where the rainfall is less plentiful and the difficulty of water conservation in a long dry season more acute.

For the benefit of those so situated, we have obtained from the Government Chemist and Analyst, Dr. E. S. Simpson, the following note on the subject in the hope that it may prove of value to our readers:—

It is within the experience of most dwellers in the Wheat Belt that, waters which are perfectly clear and colourless, are often brackish or salt to taste, whilst really soft waters are often unpleasantly clouded with clay which refuses to settle, or which, in the case of dams, rises at the least disturbance by wind or stock. These fresh but turbid waters are perfectly safe for stock to drink, but are not desirable for household use, particularly if the clay happens to be coloured red or brown by iron oxide.

The clarification of such waters for town supplies, under the control of an engineer or chemist is usually done by filtration on large sand filters with or without the use, in strictly controlled proportions, of chemicals which, by reason of their highly astringent or even poisonous character, are not desirable on a farm or small uncontrolled country supply. These latter supplies, particularly farm dams, are easily and safely clarified by the use of a natural compound widely distributed throughout the wheat belt. This is "kopi," the very finely powdered form of gypsum, which chemically consists of sulphate of lime. This kopi is a fine white or cream-coloured powder which forms low ridges round the shores of most of our salt lakes and pans, where it often forms a favourite burrowing ground for rabbits. Thrown with a shovel over the surface of a muddy dam or other water container at the rate of 2 lbs. per thousand gallons, it will be found to coagulate and settle the mud in a few hours. It is absolutely flavorless and from a dietetic standpoint, the water will be better after the addition than before.

THE FRUIT INDUSTRY.

AREA—PRODUCTION—EXPORT.

GEO. W. WICKENS, Superintendent of Horticulture.

According to the latest figures available, which refer to season 1930/31, the area in Western Australia devoted to the production of fruit increased over that of the previous season by 285 acres, and apple orchards were again the principal factor in the increase noted, the gain in this connection being 358 acres, while the main decrease for the year occurred in vineyards—198 acres.

The principal fruits produced commercially in Western Australia are—apples, pears, oranges, stone fruits and grapes, and it is interesting to note the fluctuations that have taken place during the five years' period from 1925-26 to 1930-31. In that time the area under apple trees increased by 1,492 acres, while the areas under the other kinds of fruit mentioned all showed decreases—pears by 138 acres; oranges by 350 acres; stone fruit by 99 acres; and vineyards by 504 acres; so that apple orchards now represent 46 per cent. of the total area under fruit in the State.

Particulars giving area and production of all kinds of fruit for season 1930-31 are set out in the following table:—

FRUIT PRODUCTION AND ACREAGE FOR SEASON 1930-31.

Orchards.

Kinds of Fruit.	Area.			Yield.
	Unproductive.	Productive.	Total.	
	acres.	acres.	acres.	bushels.
Oranges	449	2,435	2,884	260,382
Mandarins	22	160	182	15,108
Lemons	53	443	496	61,605
Other citrus fruits	8	21	29	2,266
Apples	3,285	7,958	11,243	749,449
Pears	110	943	1,053	80,684
Apricots	121	545	666	43,840
Peaches	168	629	797	50,233
Nectarines	57	148	205	11,469
Plums	243	697	940	57,956
Quinces	14	78	92	7,847
Figs	47	316	363	40,270
Bananas and Plantains	2	8	10	1,075
Small Fruits	...	74	74	...
All other fruits	96	224	320	...
Totals	4,675	14,679	19,354	...

Vineyards.

				cwts.
Table grapes	...	1,022	1,022	56,699
Wine grapes	...	1,136	1,136	50,133
Drying grapes	...	2,291	2,291	190,883
Not bearing vines	317	...	317	...
	317	4,449	4,766	297,715

Wine made—307,788 gallons.

DRIED FRUIT PRODUCED FROM 1930-31 SEASON'S GRAPE CROP.

----	Raisins.	Sultanas.	Currants.	Total.
Cwt. Table clusters	556	4,899	34,755	47,766
Cwt. Lexias	7,556	...	...	...

During the season 1931/32 fruit, in common with all other primary products, felt the effect of world depression, but prices for apples and pears on the overseas markets did not fall in the same proportion as those for wheat and wool; and taking the season on the whole, growers of all kinds of fruit, including citrus and grapes, have experienced a fairly satisfactory season.

A record in quantity exported to overseas markets was established during 1932—831,915½ cases having been shipped to countries outside of Australia compared with the previous largest total of 737,676 cases in 1929, and though prices realised were not as high in this as in former seasons, there has been a noticeable freedom from complaint from overseas buyers concerning the condition and quality of the fruit, the vast majority of comments in this connection being favourable. London received the bulk of the shipments, 504,042 cases being consigned to that port, which, with smaller lots to Liverpool, Hull, Southampton, Manchester and Glasgow, brought the quantity sent to the United Kingdom to 67 per cent. of the total.

The quantity of fresh grapes exported was a record for the State, but prices varied considerably, those received for some of the mid-season varieties being very low, while some shipments of Ohanez made good figures. There was a good demand and payable returns were obtained for dried vine fruits in the London market in the early part of the season. 878 tons of currants and 158 tons of lexias were shipped from Western Australia before the 23rd May, and the first currants met with a fine reception.

Particulars showing quantities of fresh fruit exported and destinations are as follow:—

SHIPMENT OF FRESH FRUIT FROM WESTERN AUSTRALIA TO OVERSEAS MARKETS FOR YEAR ENDING 30TH JUNE, 1932.

Destination	Apples	Grapes	Pears	Plums	Nectarines	Peaches	Oranges	Tomatoes	Quinces	Lemons
	cases.	cases	cases	cases	cases	cases	cases	cases	cases	cases
Batavia	5,767½	1,482	187½	81¼	2	...	691	...		146
Singapore	14,450	3,747	232¼	35	5	2	2,581	...		304
London	429,898	30,952	40,404¾	33	...	...	2,735	...	11	9
Colombo	4,086	13,035	623¼	26		2	483	...		2
Bombay ...	156	765	...							
Mauritius	421	235			...	...	320	...	...	30
Port Said ...	5,518	...	...	...			...	...	...	...
Southampton ...	620	300		...		...	...	...	...	...
Sourabaya ...	5,233	2,015	32	8	...		310	12		25
Samarang	380	250	...		...	...	...			...
Liverpool	20,537			...		...	...			...
Calcutta	...	100	...	...		...	...		...	...
Penang ...	140	40	...		...			...	...	
Hamburg	115,055	...	1,628			...	20		...	
Bremen	9,184	...	59			...	...	...		
Glasgow	26,835	...	...	...	...	...	...		...	
Hull	6,604	...	...	...	...	...	...	...	...	...
Stockholm	56,326	1,250	1,023	...	...	...	...		...	...
Rotterdam	19,330	...		...	...	...	...	...	...	...
Manchester	2,007	...	...	...	...	...	...		...	...
Durban	2,892	...			...			...		
Auckland	...	...	...	...	...	...	30	...	...	...
Shanghai	...					...	10	...		2
Rangoon	50	...			...	...	25	...		...
Antwerp	...	...	...	...	...	...	80	...	...	
Palembang	30	...	...	...	...	...	5		...	
Total	725,519½	54,171	44,189¾	183¼	7	4	7,300	12	11	518

GRAND TOTAL 831,015½ cases.

FERMENTATION AND GRANULATION OF HONEY.

H. WILLOUGHBY LANCE,
Apiculturist.

Fermentation cannot occur without the presence of yeast germs. Granulation sometimes assists fermentation and hastens it, but the yeast germs must be present in the first instance.

Yeasts are fungous germs or microscopic plants that, under suitable conditions, mutliply very rapidly. There are a large number of yeasts, but they do not all work in honey. The group that affect honey consists of what is termed the sugar tolerant yeasts; five species of this group being definitely known to cause fermentation in honey. When these little plants find conditions sufficiently favourable in the honey for growth they grow and multiply rapidly, and in growing use sugar for their food. The excretory products which are produced by the yeasts are alcohol and carbon dioxide. Analysis made of fermenting honeys shows as high as 6 per cent. by volume to be present. The carbon dioxide, being a gas, causes bubbles which give fermented honey its characteristic appearance.

For many years it was thought that fermentation was caused by what is termed unripe honey, that is to say, nectar that has been placed in the combs but has not had sufficient water evaporated from it to complete its change into ripe honey. It must be admitted that this condition is suitable for the growth of the yeast germs, but it is now been proved that it is not the cause. Yeast germs are frequently present in even ripe honey, but they do not grow as there is not sufficient moisture. Ripe honey may, however, and frequently does, especially in moist climates, ferment after it has granulated.

A Canadian student, R. M. Pugh, has shown that there is no correlation between tendency to ferment and the density of honey; nor does honey from certain floral sources ferment worse than other honey. It is merely a coincidence.

Now seeing that nectar is, as it were, the juice of the flowers, it cannot, when sucked from the nectaries of the flowers, contain yeast germs. The question, therefore, arises, How do the yeast germs obtain access to the honey? Yeasts may be present in soil, in the dust, in the air, or in the flower possibly around the nectaries; so that the bees may pick up the germs from any of these sources.

It is known that honey is a mild disinfectant, and that minute organisms that get into it accidently are usually quickly killed. One would, therefore, expect this to happen to yeast germs which may enter it. There are, however, certain conditions of honey in which the yeasts not only live, but thrive and grow in it. Some yeasts will thrive in honey with as low a water content as 9 per cent., but 20 per cent. is the most suitable for most of them.

It is well known that honey that is exposed to a moist atmosphere attracts moisture to it. It is the levulose sugar in the honey that absorbs the moisture, and it is not uncommon to find honey that has been exposed to a moist atmosphere with a thin film of watery honey on top. This is the levulose with an excess of moisture, and a suitable condition for the growth of the yeast.

There are, however, many cases where well-ripened and granulated honey ferments. When honeys granulate the dextrose forms crystals, and one molecule of water is incorporated in each crystal. These have a water content of over 9

per cent., which is locked up and becomes inactive. All water beyond the 9 per cent. in the crystals becomes part of the liquid portion, which consists of the levulose sugar, mineral and other substances, this solution forming a thin film around the dextrose crystals, and in some cases where there is an excess of this solution the excess rises to the top, leaving the crystaline portion at the bottom.

The original water of the honey in which the dextrose was formerly dissolved has been released to assist in forming the solution of levulose, sacrose, and other materials in the composition of the honey, and may result in a solution with as high a water content as 32 per cent., which is far in excess of the water content of unripe honey. This explains why ripe honey that has granulated ferments quite as frequently as unripe honey, and more frequently than honey remaining in the liquid condition.

With such a high water content as may occur in granulated honey, yeasts can thrive, and often do great damage to stored honey.

Fortunately, from general reports, we do not appear to be troubled with fermentation of honey in Western Australia to anything like the extent that they are in America. This is doubtless due to our warm dry climate. As a general rule our honey ripens quickly, and when there is a heavy honey flow on in dry weather there are many combs of uncapped but ripe honey in the hive, the bees being too busy in the field to stop to cap it.

It is, however, most important that no unripe honey should be extracted. If a hive is very full of uncapped honey, and the beekeeper wishes to extract some of this, he can usually ascertain if the honey is ripe by holding the comb at an angle and giving it a sharp shake. If none of the honey comes out, it is usually quite safe to extract. If, however, the honey is thin and some of it shakes out, the comb should be replaced in the hive.

A factor that sometimes has an influence on the growth of yeasts and fermentation is the peculiarity of honeys of different densities of not mixing readily.

It is frequently noticed that when different honeys, even extracted on the same day, are run into the settling tank, one honey goes to the bottom and the other rises to the top. In a case of this kind, if there happen to be yeast germs in the honey, it is quite likely that the thin honey at the top may ferment, especially if the tank is not carefully covered to prevent the ingress of moist air. If, therefore, it is noticed that the honeys are separating, it is advisable to at once stir and thoroughly mix the honey in the tank to bring it all to the same density; or better still, to remove it from the tank and heat it to about 150 deg. Fah., so as to prevent the growth of any yeast germs that may be present.

A high water content of honey is always liable to cause trouble with fermentation, and Fabian, of the Michigan State College, found that a water content of more than 21 per cent. was favourable to the growth of yeasts.

However, in some cases, especially with granulated honey, fermentation occurs with a comparatively low water content. Yeasts may remain dormant in honey for a long time without causing fermentation, but they begin to grow as soon as the water content of any part, especially the upper surface, is increased.

Storage in moist places, especially with high temperatures, greatly increases the absorption of moisture to the point where the density is reduced and conditions are produced suitable to the growth of the yeasts.

As has been already pointed out, granulation is no security against fermentation. From data obtained by R. M. Pugh, a Canadian student, it is shown that in America a surprisingly high percentage of honeys fermented after being kept for some months.

The heating of honey to between 150 and 160 degrees Fah. destroys the yeasts, but care must be taken that it is not heated above 160 degrees, or the colour or flavour or both may be spoilt. Even after such heating care must be taken that it is not contaminated by yeast germs, for should they enter the honey, and later it should granulate, there is the possibility of fermentation. It must, therefore, be remembered that not only should honey be well ripened before extracting, but every care must be exercised to prevent the absorption of water from the atmosphere after extracting.

Investigations have shown that much of the infection comes from the hive and its surroundings, and that yeasts also gain access to the honey from the apparatus in the extracting oom, extractor pipes, tanks, etc. All apparatus and utensils that are used should, therefore, as far as possible be thoroughly cleaned with hot water and dried after each extraction, as yeast germs may be carried by these and passed on to honey that would otherwise be free from danger.

The extracting room should be kept clean and free from dust, and for this reason it must have a solid floor that can be cleansed, as provided for in the Regulations under "The Bees Act, 1930."

The question arises, What can be done with fermented honey? A good plan is to make it into vinegar, which usually sells readily; or it may be reconditioned by heating it to 150 degrees. Yeast germs are destroyed at 145 degrees. If the honey is kept at a temperature of between 150 and 160 degrees for about an hour, not only will the germs be destroyed, but some of the excess moisture will be driven off, and the scum rise to the top. It can then be skimmed and strained, and will not be liable to ferment again unless it is further contaminated.

The honey should be cooled as quickly as possible after heating to prevent loss of flavour and the darkening of the honey.

Now, as regards granulation, this was at one time a source of trouble to beekeepers, as after freshly extracted honey had been bottled and sold to storekeepers, it frequently granulated on their shelves and the public would not buy it, as the idea got abroad that such honey was adulterated. However, by reason of propaganda and education of the public, this fallacy and prejudice is rapidly disappearing, and there is now a large demand for good quality granulated honey, so much so that some large producers find it necessary to hasten granulation as much as possible.

It is generally known that honey kept in a cool place granulates more rapidly than in a hot place. Some honeys granulate much more rapidly than others, and some never granulate. Recent experiments go to show that granulation takes place more rapidly when the honey is subject to frequent changes of temperature. Also, it may not be known that liquid honey may in many cases be made to granulate much more rapidly by adding a small quantity of granulated honey to it. The smoothness and size of the granules is influenced by the quality of the added honey; thus, if honey with a coarse grain is added, there will be a tendency for all the honey to granulate with a coarse grain, whereas, if the added honey has a fine grain, the whole bulk will also have a finer grain.

The process of granulation is also hastened by stirring it every day, which also tends to make it granulate with a fine grain and with a light creamy appearance. The stirring will also bring the scum to the top, and this should be skimmed off before the honey is run into containers. This should be done as soon as the stirring has brought it to a pasty condition, as, if it is left long after it has arrived at this condition, it will set too hard to be run off.

THE FEEDING OF LIVE STOCK.

An Explanation of some of the Terms in Use.

L. C. SNOOK,
Agricultural Adviser.

The scientific investigator often finds difficulty in interesting the practical man in the nature of his work or the results being obtained. Not the least important reason for this is the use by the scientist of words or expressions with which the layman is not familiar. The practical farmer often has a deep-rooted antipathy to technical terms, and will not readily read articles containing them. For this reason advisory officers tend to "break down" or simplify their diction, and academic expressions are assiduously avoided.

Within limits, this practice may be sound—there is no greater folly than talking "over the heads" of one's audience; but it is well to remember that scientific terms have been evolved and are used because they are concise and specific. A writer is considerably handicapped in his work when it is necessary to replace such convenient and workmanlike terms by lengthy phrases made up of more elementary words. One of the greatest advantages of education is improved facility of expression, and a well stocked vocabulary will enable a reader to take full advantage of the numerous valuable articles now available. All livestock owners are interested in feeding problems, but maybe the inability to understand only half-a-dozen terms may restrict one's reading considerably. To help remove this disability, a number of important expressions used with reference to feeding problems are explained. Knowledge of these will prove of lasting benefit.

Analyses of Foodstuffs.—The composition of a foodstuff is determined by chemical analysis. The constituents of most importance are: moisture, crude protein, soluble carbohydrate, crude fat, crude fibre, and ash.

Moisture.—It is absolutely essential to determine the moisture (water) content prior to analysis, as for purposes of comparison all results must be reduced to a dry matter basis. It is always wise to note the moisture content of a foodstuff—much expensive water is purchased as "food."

Crude Protein.—Proteins are nitrogenous compounds and constitute the most valuable (hence most expensive) part of many concentrates. During the dry summer, Western Australian pastures become deficient in digestible protein, and it is important that the acute shortage be eliminated. Until the farmer has learned to grow and store the necessary protein rich foods, it is vital that he should be able to estimate the protein value of the various concentrates now on the market. To do this, one must be able to appreciate the significance of a table of analyses.

Soluble Carbohydrates (or Nitrogen free extract).—This consists of energy or fat-producing material. The farmer grows most of the "energy" on the farm, hence consideration of this factor is not of such vital importance.

Crude Fat or Ether Extract.—This is the fraction of the foodstuff soluble in ether and consists mostly of fatty substances. The fats have more than double the "heat" or "energy" value of the carbohydrates but serve a similar purpose.

Crude Fibre.—This is the insoluble residue which remains after all the other soluble constituents have been removed. Some of this crude fibre may be broken down by fermentation in the colon of the horse or the paunch of the ruminant, but it is generally assumed to be indigestible and of no commercial value.

Ash.—This contains the various minerals originally dispersed through the foodstuff. It is only of recent years that the significance of minerals in the diet have been realised, and it is still very difficult to obtain reliable data regarding the compositions of the ash present in various foodstuffs. It is of little value to know merely the total percentage of ash present, as the constituents vary greatly. For instance, bran contains considerable ash, and hence it may be considered an excellent source of bone-building material. However, bran ash consists predominantly of phosphorous (3.3 per cent. P_2O_5; Ingle), and contains very little lime (0.3 per cent. CaO; Ingle), which is equally essential. With lucerne hay the reverse composition is seen—there may be 4½ parts of lime in lucerne ash to every 1 part of phosphorous (as P_2O_5). This explains why lucerne hay and cereal grains combine so well in a ration.

In future tables showing the composition of foodstuffs, the nature of the ash will prove a very essential section.

Digestive Co-efficient.—The value of a foodstuff depends not only on the total amount of material present, but upon the extent to which the various constituents are actually utilised by the animal. Food must be assimilated to prove of value. Careful experiments have been carried out to determine the digestibility of various foods when fed to different classes of livestock. From the data obtained, tables have been drawn up which show the number of pounds of a constituent in a given food which will be digested per 100 lb. of the constituent which is fed. These figures constitute the digestive co-efficients. An example will best show their value in practical application. In the table at the end of this article it will be seen that, when oaten grain is fed to ruminants, the digestive co-efficient for protein is 78. This means that of every 100 lbs. of protein fed in the oats, 78 lbs. will be digested. If the oats contain 10 per cent. of total protein, then the percentage of digestible protein is—

$$\frac{10}{1} \times \frac{78}{100} = 7 \cdot 8\ \%$$

The original analysis of a foodstuff by a chemist is of little practical value, as no idea of the digestibility is obtained. By use of the digestive co-efficient, a truer index of the feeding value will result.

Starch Equivalent.—Every person interested in the feeding of livestock should understand what is meant by the term "Starch Equivalent." This is a unit whereby the heat or fat-producing value of foods may be measured. Just as the value of a miscellaneous collection of articles may be compared by expressing the cost of each in some common money unit (say shillings), so also the worth of a diverse assortment of foodstuffs may be gauged per medium of the common measuring rod—the the Starch Equivalent. Also, the food requireents of various animals are known in terms of Starch Equivalent, and the most economical ration may be readily calculated.

The Starch Equivalent is the number of units of starch which have the same heating or fattening value as one hundred units of the given foodstuff. (Be careful to note that it is a measure of the energy value only—the protein and mineral content are not considered.) The starch equivalent of wheat grain may be taken as 72. This implies that 72 lbs. of starch will produce as much fat in, say, a steer as will 100 lb. of wheat. The starch equivalent for oaten grain is about 60, thus the relative fattening values of wheat and oats in this case are 72 : 60.

It is a very simple matter to work out the theoretical starch equivalent of any food of which the percentage digestible constituents are known. The method is based on the assumption that the digestible carbohydrates (including digestible fibre)

and digestible protein have a value equal to starch, and that the digestible fat is $2\frac{1}{4}$ times as valuable as carbohydrate. The starch equivalent is obtained as illustrated in the following example:—

Hay from Chapman Experiment Farm—Analysed by Western Australian Government Analyst.

	Percentage.	×	Factor.	=	Starch Equiv.
Digestible Protein	4·2	×	1	=	4·2
„ Carbohydrate ...	23·4	×	1	=	23·4
„ Fibre	22·4	×	1	=	22·4
„ Fat	1·1	×	$2\frac{1}{4}$	=	2·5
			Total ...		52·5 S.E.

This signifies that 100 lbs. of the hay has the same fattening or heating value as 52.5 lbs. of starch.

The method of obtaining the starch equivalent by calculation is sometimes subject to error, as foods vary in value according to the use to which they are put. For fattening a steer. protein may not be as valuable as starch, and the factor used in multiplication should be, say, 0.9 instead of 1.0, while for milk production Halnan claims that proteins are worth 1.43 times as much as starch. Still, for the purpose of obtaining a rough guide to relative values, the factors used in the example given above are sufficiently accurate. Remember to use the *percentage digestible constituents* and not the total content as determined by original chemical analyses.

Protein Requirements.—It is not sufficient that one should know only the heating or fattening value of a food, as given by the starch equivalent. A certain proportion of protein must be present, the protein requirements varying greatly according to the purpose for which the animal is being fed. A mature beast being fattened or working will need relatively little protein, while a growing or lactating animal will require considerable quantities. Consideration of these requirements leads to the question of albuminoid or nutritive ratios.

Albuminoid or Nutritive Ratios.—Albuminoid is an old term for protein, and the albuminoid ratio is merely the ratio of digestible protein to digestible non-protein. Expressed as a fraction it appears thus:—

$$\frac{\text{Digestible Carbohydrate} + \text{Digestible Fibre} + 2\tfrac{1}{4}\ \text{Digestible Fat.}}{\text{Digestible Protein.}}$$

The ration may be "wide," as seen in mature hay (1 part digestible protein to 14 parts of digestible non-protein—written briefly as 1 : 14), or "narrow" as seen in skim milk (1 : 2). A narrow ration is rich in protein, while a wide ration would be poor.

Foods vary greatly in their protein content, but the needs of a given animal are restricted within certain well-defined limits. The feeding of a ration of an unsuitable nutritive ratio entails waste. For this reason farmers should endeavour to feed a balanced ration—a ration in which the ratio of protein to non-protein is adjusted to the animal's needs. The approximate nuritive ratios for various types of livestock are as follow:—

Working horses	1	:	12
Sheep	1	:	7
Beef Cattle	1	:	8
Milk production	1	:	4·5 - 5·0
Young growing animals	1	:	4·0
Older growing animals	1	:	4·5 — 6·0

It should prove an interesting and, maybe, a profitable exercise for those farmers who hand-feed pigs or dairy cows, to work out the nutritive ratio of the ration being used. The tables at the end of this article probably will supply all the requisite information.

Calculating Rations.—Nutritive ratios are useful as a means of comparing the protein contents of alternative foodstuffs, but for purposes of calculating the food requirements of various animals it is much simpler to work in terms of pounds of starch equivalent and pounds of digestible protein. The requirements of a given animal may be stated very accurately in these terms, and the sole problem is to so adjust the ration that these requirements are satisfied.

An animal requires food to maintain its bodily functions—the maintenance requirements—and food for production. It is the food consumed in excess of maintenance needs which is the source of profit. This explains the folly of underfeeding. It stands to reason that an animal will satisfy its own bodily wants before it will produce milk or wool in any quantity. The feeding of dairy cows has been reduced to a very scientific basis, and will provide an excellent example of the methods employed.

A 1,000 lb.* cow requires 6.0 lb. starch equivalent per day for maintenance. To produce one gallon of 4 per cent. milk a further 2½ lbs. of starch equivalent are required. The maintenance ration must include 0.5 lb. of digestible protein, while the 2½ lb. starch equivalent required for the gallon of milk must contain another half-pound of digestible protein.

Consider the needs of a 1,000 lb. cow yielding 3 gallons of 4 per cent. milk per day. Her requirements may be tabulated so—

	lb. Starch Equiv. to include	lb. Dig. Protein.
Maintenance	6·0	0·5
Production (3 gals.) ...	7·5	1·5
	13·5	2·0

If an analysis of the foods being utilised is available, the required ration may be worked out to a nicety. Assume that a cow has access to good green pasture and that crushed oats and good meadow hay may be fed in the bales. What is, theoretically, the correct ration to feed? The following is very close to the mark:—

	lb. Starch Equiv. including	lb. Protein.
Pasture (23lb. dry matter)	11·04	1·75
Crushed Oats (2lb.) ...	1·20	·14
Meadow Hay (4lb.) ...	1·28	·16
	13·52	2·05

It should be noted that only well managed pasture would have a value equal to 48 lbs. starch equivalent per 100 lbs. *dry weight*—this including 8 lbs. digestible protein (the figure used in the above calculation), but, nevertheless, the worth of good grazing cannot receive too much emphasis. The cows in one of the largest and best producing herds in this State receive no concentrates during the winter months, meadow hay constituting the only supplementary ration, and individual cows maintain a production of over 40 lbs. of milk per day on this economical diet. It is cheaper to fertilise pasture than to feed concentrates.

The foregoing may appear somewhat involved to an inexperienced reader, but on a second perusal much of the apparent difficulty will vanish. It is typical of human nature to shun unfamiliar things, especially where bodily or mental effort is

* An average Jersey or Guernsey cow would weigh about 850-900 lbs. when mature, while a well-developed Australian Illawarra Shorthorn cow would scale about 1,100 lbs. live-weight.

required, but do not be frightened by scientific terms—sooner or later the need for understanding them will arise. Once understood, a technical expression becomes a very useful servant. The tendency to "talk down" to the farmer should not be encouraged. On the contrary, vocabularies should be widened so as one's reading is no longer hampered by ambiguous phrases. It is hoped that this article will give a clearer understanding to several very useful expressions.

TABLE 1.

DIGESTION COEFFICIENTS—(AFTER INGLE.)

—	For Ruminants.				For Pigs.			
	Protein.	Carbo-Hydrates.	Fat.	Crude Fibre.	Protein.	Carbo-Hydrates.	Fat.	Crude Fibre.
Wheat, grain	78	92	65	40	80	83	70	60
Oats	76	76	80	28	...	...	...	...
Peas	86	93	65	46	90	96	49	70
Wheat, bran	79	71	71	26	75	66	72	33
Wheat pollard	82	85	85	36	77	76	87	36
Linseed Meal	84	82	95	54	86	85	80	12
Meat Meal	93	...	98	..	97	..	86	...
Pasture, spring	75	79	66	73	...	...	...	...
Clover, before flowering ...	74	83	65	60	..	..	.	...
Clover, end of flowering ...	59	71	45	39	...	...	.	...
					For Horses			
Meadow-hay, good ..	65	68	57	63	63	65	22	48
Meadow-hay, poor	50	59	49	55	55	52	29	38
Lucerne-hay early flower ..	76	68	46	42	73	70	14	46
Wheaten-hay	62	57	34	58	60	57	40	40
Oaten-hay	54	56	61	52	54	56	40	45
Wheaten Straw	4	37	31	50	28	28	..	18
Silage	75	67	75	61	...	..	...	...

TABLE 2.

PERCENTAGE COMPOSITION OF FOODSTUFFS—(KELLNER).

— —	Water.	Ash.	Digestible Constituents.				Starch Equivalent.
			Protein.	Carbo-Hydrates.	Fat.	Fibre	
Wheat grain	13·4	1 7	10·2	63·5	1·2	0·9	72
Oats	13 3	3·1	8 0	44·8	4·0	2·6	60
Peas	14·0	2·8	19·4	49·9	1·0	2·5	70
Wheat bran	13·2	4 5	12·9	40·5	3 7	2 1	50
Wheat pollard	12·6	2·7	11·0	52 2	2·9	4·3	50
Linseed meal	11·0	6·5	28·8	25·4	7·9	4 3	72
Meat meal	10·0	6·0	40·0	...	12·5	..	62
Pasture, young	75	2 2	3·4	8·1	5·6	2 8	13·1
Pasture, mature	70	3·2	1·0	8·5	0·2	5·0	8·0
Sub. Clover (29th August)	84	1·28	3·0	6·4	0·2	1·6	11·0*
Sub. Clover (5th December)	75	1·67	2·6	9 3	0·2	2 0	10·0*
Oats, 8in. high	87	1·6	3·4	3·2	0 5	1 2	8·9
Meadow-hay, good ...	15	7 0	7·4	27·0	1·3	13·8	36·2
Meadow-hay, poor ...	14·3	5 0	3 4	19·3	0 5	15 6	18 9
Lucerne-hay, before flowering	16·0	7·3	12·1	21·1	1·1	11 3	26·5
Lucerne-hay, in flower ...	16·5	8·0	9·7	18 1	1·2	13 2	22·4
Wheaten-hay (Chapman)	14·38	6·75	4 2	23·4	1·1	22·4	35·5*
Oaten (in flower)	11·5	6·1	5·6	26·7	1·7	18·1	35·2
Wheaten straw	14·3	4·8	0·2	13·3	0·4	20·4	10·0
Silage (Oats)	76·3	1·8	1·1	5·9	0·4	5·1	8·9
Silage (Sub. clover) ...	72·0	3·23	4·2	8·9	1 0	2·7	10·0

(the S.E. of fibrous goods is much less than the calculated value because of energy "wasted" in digestion.)
(* Analyses by West Australian Government Analyst.)

APPLE POWDERY MILDEW.

GEO. W. WICKENS,
Superintendent of Horticulture.

I can well remember when Powdery Mildew was a disease of minor importance to apple growers in Western Australia, confined principally to young Northern Spy stocks in nurseries, and even there it was not much in evidence. At a later period, which, if my memory serves me rightly, was in 1907, I noticed it was showing up in a number of orchards in the South-West, that it was to be found mainly on Rome Beauty, Five Crown, and Northern Spy (three varieties fast disappearing from commercial plantations) and that though present it was not causing much damage. Since then it has spread little by little until now I doubt if there is an apple orchard in the State completely free, some being badly affected, others only in a minor degree, but taken in the aggregate the disease is causing considerable loss to the industry.

Apparently no variety is immune, but Cleopatra, Jonathan, Nickajack, and Rome Beauty are amongst the worst, while Yates and Dunns are two of the most resistant. Once the disease has obtained firm hold it is not readily controlled, and last year some growers, unfortunately, adopted measures which resulted in 50 per cent. of the Cleopatra crops being so badly marked with spray injury as to be practically unsaleable.

The spray referred to was "Iron Sulphide" (lime, sulphur and sulphate of iron), but it was not made in accordance with the prescribed formula, neither was it applied at the proper time; the latter being the main cause of the trouble, "Sulphur Sunburn" resulting after high temperatures. In the United States where Powdery Mildew is looked upon as a serious disease in apple orchards, a lot of experimental work has been carried out, and it was found that when shade temperature rose to 90°, even though a fortnight after spraying, considerable damage resulted both to fruit and foliage, and this occurred when either lime sulphur alone or iron sulphide had been applied. The orchards referred to above as being injured in this State last year were sprayed in November and December, a time when high temperatures are frequently experienced.

I think the most common method of attempts at control adopted by growers here is to incorporate a few lbs. of sulphate of iron with the lime sulphur they are using for the regular dormant spray in winter. But neither lime sulphur nor iron sulphide will control Powdery Mildew if applied while the trees are dormant. A treatment that has given partial success is the application of Atomic Sulphur at the rate of one lb. in 10 gallons of water in spring and early summer, but where the infection is severe no very tangible results have been secured.

The best results from spraying have been obtained by using iron sulphide when the blossoms are in the pink and petal fall stages, the sulphide being made by dissolving in a barrel containing 25 gallons of cold water 6 lbs. of sulphate of iron, and to this adding gradually, stirring all the time, 12 pints of commercial lime sulphur 32° Beaume. The addition of lime sulphur produces a black precipitate which settles to the bottom of the barrel, and if the liquid on top is clear, a little more lime sulphur must be added, the mixture stirred and again allowed to settle, the operation being repeated until the liquid shows a pale yellowish tint. Then the liquid (whch has no value) must be drawn off and

sufficient water added to the mixture remaining in the barrel to bring it to 25 gallons, making a stock solution to be broken down to 1 in 10 before using.

This method of making sounds laborious and lengthy, but in actual practice the operator, after a few trials, knows the exact quantity of lime sulphur to add to obtain the required result and this does away with the time spent adding further small quantities, waiting for settlement, and repeated examinations of liquid.

Although this formula has been known for many years and was tried out departmentally with a large measure of success by Mr. Flintoff, Orchard Supervisor at Bridgetown, it has never been favoured by growers, the method of making apparently being considered too intricate, and the rough and ready style has been adopted of mixing sulphate of iron with the lime sulphur in the spray tank, and either applying the mixture in winter when it has no appreciable effect, or in summer when there is grave risk of causing damage to fruit and foliage.

One method of reducing infection that should receive more attention is to prune out affected shoots; these are readily descernible by their whitish appearance and malformed terminal buds, and can be removed either during the operations of winter pruning, or at any convenient time during summer or autumn.

In Bulletin No. 712 of the United States Department of Agriculture dealing with experiments made in that country, the following conclusions are given:—

"Pruning out diseased shoots cannot be depended upon alone to effect control of the disease when it is present in epidemic form," and

"The disease is readily controlled by applications of sulphur sprays during the growing season. However, after the advent of burning sunshine, the use of sulphur spray materials is certain to cause severe fruit injury."

In the same bulletin the following spraying schedule is recommended:—

"First Application—Spray with lime sulphur solution 1 to 50 when the cluster buds have separated, but before the blossoms open—the pink spray."

"Second Application—Spray with same material as soon as the petals fall and before the calyx is closed."

"Third Application—Spray with ammoniacal copper carbonate about three or four weeks after the second application."

The method of making No. 3 is as follows:—"Dissolve 5ozs. of copper carbonate in 3 pints of ammonia (25 per cent. solution which should be diluted before using). Dilute to 50 gallons in spray tank."

If the affected growths are removed from the trees, and sprays Nos. 1 and 2 are applied at the stated times, I very much doubt if No. 3 would be required in Western Australia. No. 1—pink spray—would be applied to most of our varieties in the early part of October, and No. 2 about the end of that month. This would eliminate danger from burning on account of high temperatures, and in addition to controlling Powdery Mildew would have a decidedly beneficial effect in destroying Red Mite, which at that time of the year—just emerging from the egg stage—is most susceptible.

I strongly advise apple growers whose trees are suffering from the effects of Powdery Mildew to make a test of sprays Nos. 1 and 2 in October of this year, making the experiment if only with 100 trees, so that some definite local knowledge may be gained, and if there are any who make the test, I shall esteem it a favour if they let the District Orchard Supervisor know so that the results of the work can be carefully watched and recorded for the benefit of all.

THE PRESERVATIVE TREATMENT OF FENCE POSTS.

(With Particular Reference to Western Australia.)

By J. E. CUMMINS, M.Sc., Council for Scientific and Industrial Research.

(Continued.)

8. PRACTICAL TREATMENT OF FENCE POSTS.

Preparation of Fence Posts for Treatment.—For all the preservative processes discussed, proper seasoning before treatment is essential in order to obtain good results. There are two reasons for this. Firstly, in green timber the wood cells are either completely or partially filled with sap—which is mainly water. On drying, this water is removed from the wood and thus a space is formed which can be used for the introduction later of preservative liquids. The more of this moisture removed, the more space there will be for preservatives to enter. Secondly, when wood dries, especially in the form of round posts, it usually cracks, the cracks extending some distance in from the surface. If the posts are treated before these cracks develop, then, on drying, cracks will extend through the treated area and expose untreated wood. They will therefore allow termites and decay to gain entry to the untreated wood in the centre of the post. If the posts are first dried, these seasoning cracks are formed before treatment, and, as a result, the surfaces of each crack are thoroughly treated with preservative, and the entrance of decay or termites to the untreated wood in the centre is prevented.

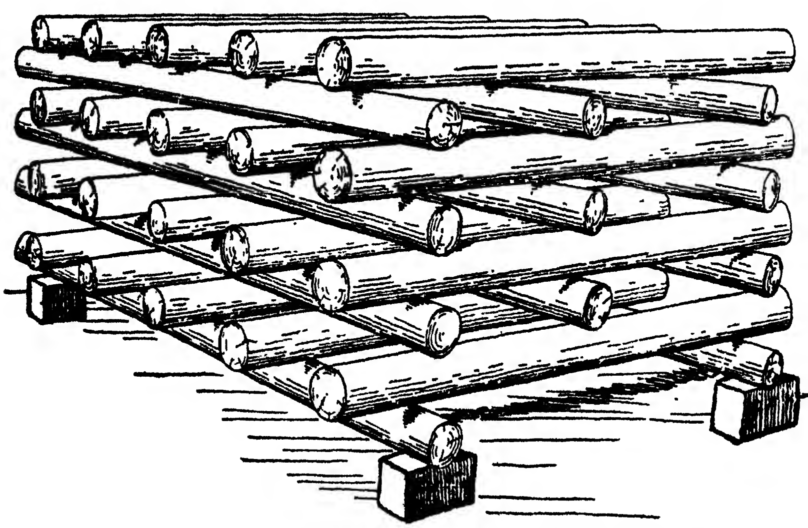


FIG. 6.—A good method of piling fence posts for seasoning.

As soon after felling as possible, the posts should be barked, care being taken to remove *all* the bark from the portion that is to be treated. In the case of *Pinus radiata* (*insignis*), a very thin inner bark often adheres very strongly to the wood. This thin inner bark often prevents penetration of the preservative, so every care should be taken to remove it from the portion to be treated. In the case of jarrah and redgum (marri), it has been found that small amounts of the inner white bark do not appear to affect the penetration but, as an added precaution, they should be removed.

For seasoning, a site should be chosen that will allow prevailing winds to blow through the stacks. For preference, the site should be on high ground, and should be well drained. In building the stack, care should be taken to have good foundations which will raise the stack about 1 foot off the ground (see Fig. 6). In cases where no suitable foundations are available, large fence posts can be used as a base. In bad termite localities, frequent inspection of the base of such a stack is necessary, because termites have been found to build their way over foundations and to attack the posts within a very short time. Provision for efficient air circulation should be made by providing a space between posts. A good method of open piling is shown in Fig. 6. Only three posts are used in each alternate layer; the other layers, with the posts at right angles to the first, have from five to ten posts. The number depends on the length and diameter of the posts, but each post in these rows must be carefully separated from its neighbour. It is sometimes possible to obtain more rapid seasoning by increasing the width of the space between posts, but if this is done in the summer time, frequent inspection of the stacks should be made to see that they are not cracking too severely. If this occurs, the posts should be placed closer together. A better method to use with timber which cracks excessively when quickly seasoned is to cut and stack the fence posts in the winter, when the drying of the timber is much slower, and there is less tendency to crack. By summer time, the timber will be partially dried and less liable to develop further cracks. Barking will also be found to be easier in the winter.

To obtain good treatment results, posts should be air-seasoned for about six months, and treated during a period of dry weather, unless arrangements can be made to stack the seasoned posts under cover in a shed. Under no condition should posts which have been recently wet by rain be treated. In the Eastern wheat belt of Western Australia, posts cut at the end of winter or in the spring should be ready for treatment at the end of summer.

Fig. 7.—A badly piled stack of fence posts. There is very little drying in such a stack, and conditions are very suitable for both decay and termite attack during storage.

The stacking of untreated posts, particularly green ones, in a close stack, as shown in Fig. 7, is bad practice, and decay or termite attack is very liable to occur before treatment.

Construction of Farm Treating Plant for Butt Treatment by the Open Tank Process.—The essential plant required consists of one or more treating tanks, the number depending on the amount of material to be treated, and a thermometer. Provision should be made for heating at least one of the tanks.

For the farm treatment of ordinary 5-ft. to 6-ft. fence posts, which are generally set to a depth of 18 inches to 22 inches, the cheapest and most easily obtained tank is the ordinary 45 gallon oil drum. These drums measure 34 inches deep by 22 inches diameter, and will permit treatment of the butt ends of the posts to a height of 2ft. 6in. Where a longer length of treated material is required, any tank which is sufficiently strong to hold the posts and solution which is free of leaks, and which can be satisfactorily heated, will be suitable.

A very satisfactory and easily-handled unit consists of four drums for treating, together with one or two extra drums for storage of solutions. The tops of the drums should be removed, and the insides wiped clean with waste cloth. Two of the drums are required to be heated and fireplaces should be constructed for

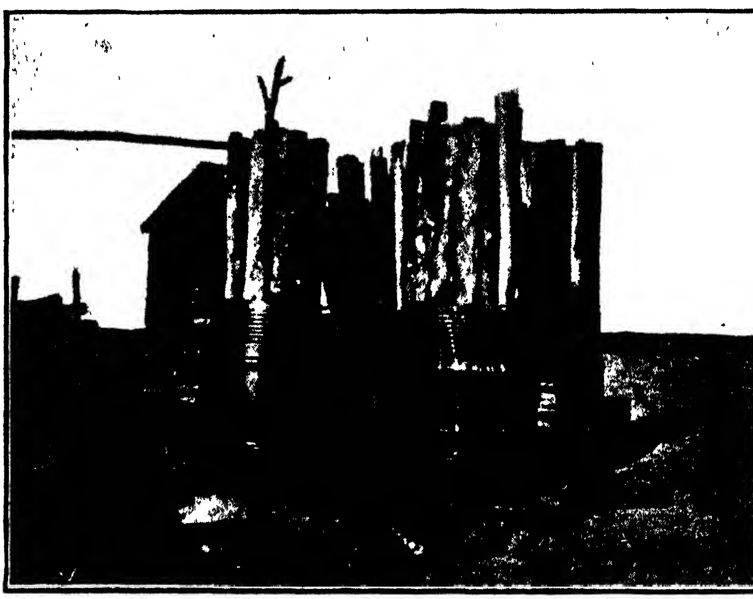


FIG. 8.—A simple fence post treating plant for use on the farm.

these. Some provision should be made for reducing loss of heat from the fire. A suitable arrangement is shown in Fig. 8. The two drums in the foreground are the heating drums, and those in the background, the cooling drums. In this case, two short lengths of old rail were used as supports, and the fireplaces were excavated slightly. The tops of the drums were used for dampers, and old pieces of galvanised roofing iron and flattened petrol tins were used for protecting the fire from the wind.

The best thermometer is a mercury thermometer reading in degrees Fahrenheit (°F.) with a temperature range up to 240°F. These cost about 3s. 6d.

If it is desired to maintain close control of the water solutions, a special hydrometer can be used (see Appendix 2).

Details of Butt Treatment Using Creosote and Oil.—The creosote and oil mixture is prepared by thoroughly mixing together *2 parts of creosote to 1 part of crude or fuel oil by volume.* For the preparation of 45 gallons of the mixture, 30 gallons of creosote should be thoroughly mixed with 15 gallons of oil. When using 3-in. to 4-in. average butt diameter posts, fill each drum to about the 18-in. mark, *i.e.*, add about 25 gallons of preservative solution. Usually, it is preferable to have a little less oil than will be actually required, as it is easier to add than to remove hot oil from the drums. For convenience, a distinct mark should be made on the outside of the drum corresponding to a height of 2ft. 6in., the length of post to be treated. The oil in the drums over the fires should be heated until a temperature of about 200°F. to 210°F. is reached. The posts should then be placed vertically in the drums, butt down, **care being taken not to splash the oil mixture into the fire.** When the drum is full of posts, the height of the preservative in the drum should correspond with the 2ft. 6in. height mark. If it does not, oil is added or taken from the drum until the required level is obtained. Heating of the drum and its contents is continued and the temperature noted. The oil should not be heated above about 210°F. as temperatures above this cause considerable loss of preservative by evaporation. When the heating period for the species being treated (see Table 1) is completed, the posts are quickly removed from the hot drum and placed in the cold drum immediately behind or alongside it. This cooling drum should contain about 1ft. 6in. depth, or about 25 gallons of solution. The heating drum can be refilled with posts and the heating continued as before. In each case, the time of the heating period is calculated from the time that all of the posts are placed in the hot oil. If the species of timber being treated requires a 4 hours' heating period, only two sets of treatments per day would probably be practicable. In this case, at the end of the heating period for the second treatment, the posts can be left in the drum and the fire drawn or allowed to burn out and the drum and its contents allowed to cool overnight. It is during the cooling period that the main part of the penetration and absorption of the preservative by the wood occurs. In the early part of the cooling, this is more rapid and the level of solution in the cooling drum and heating drum during cooling should be watched and more oil added from the storage supply to keep the oil to the 2ft. 6in. level. The posts should be removed from both drums the next morning, and the solution in the hot drums re-heated in readiness for further treatments.

With some types of creosotes it will be found after overnight cooling, particularly in cold weather, that the creosote and oil mixture in the treating drums is very thick and sticks to the posts when they are removed. This thick surface coat is an actual loss of preservative, it also makes the posts very dirty to handle, and it will run off in the stacks or sheds or wherever the treated posts may be kept until use. In such cases, the posts should not be removed until the oil has been warmed. Similarly, the posts in the cooling drums can be allowed to stand several hours longer, depending on the time of treatment being used, until they are warmed up by the surrounding air or sun, or else they can be removed from the cooling drum and dipped in the hot oil for a few minutes and then removed to the stacks.

When heating the posts in the oil, care should be taken not to use too large a fire as there will be danger of the oil boiling over. If this does happen, it is probable that the oil and posts in the treating drum will

catch fire. The rate of heating of the oil can be followed by using the thermometer at regular intervals. Approximately one hour is usually required to heat the oil alone to 210° F. using a good fire. Placing the posts in the drum cools the oil, but once the temperature is again reached, a very small fire is sufficient to keep it heated. With a little experience the fire can be easily regulated so that a minimum of attention is required.

In the instructions given above, the posts are placed in hot solution. This method has been found to be very convenient, but, if it is more practicable, the posts can be placed directly in the cold solution and heated up at the same time. If this is done, the drums will require closer watching to prevent heating above the temperature of 210° F. with the attendant danger of boiling over.

In the treatment of pine posts or the less dense hardwood timbers, it will be found that the posts float in the solution, and some difficulty is experienced in setting them upright in the drums. This can be corrected by constructing a false bottom, which can be made from the top of the drum by nailing wooden strips or riveting iron strips on one side. Screws or nails are inserted into the strips so that they protrude upwards about ½ inch to ¾ inch in height. The false bottom is placed in the bottom of the treating drum so that the projecting nails or screws point upwards.

Details of Butt Treatment, using Water Solutions.—When using the water solutions discussed below, it is advisable to erect a further drum—apart from the treating drums—for preparing solutions, particularly if large numbers of posts are to be treated. This drum should be erected over a suitable fireplace.

Zinc Chloride and White Arsenic Solution.—Zinc chloride can be purchased as a solid, which is about 100 per cent. zinc chloride, or in a solution with water containing about 50 per cent. zinc chloride.

In order to make 40 gallons of preservative solution, the 45-gallon oil-drum is filled to a height of 2ft. 2in. with cold water. A mark should be made at this height. To the water is added 14½ lb. of solid zinc chloride or the equivalent amount of the concentrated zinc chloride solution. Add 8½ lb. of white arsenic and heat the drum to boiling. Boil vigorously until all the arsenic is dissolved, which should take about 30 minutes. It will be found that the white arsenic will rise to the surface, and will be difficult to wet by stirring, but good boiling and stirring will soon dissolve it. During the boiling, water should be added to make up for evaporation, and after cooling, if the solution height is below the 40-gallon mark (2ft. 2in.), it should be made up by again adding water.*

The treatment of the posts is carried out similarly to that with creosote, except that the solution is brought to the boil and the posts boiled in the solution according to the schedules given in Table 2. As water evaporates quickly from the boiling solution, more attention is required, and water only should be added to

* To obtain the density or strength of this solution, allow it to cool, and either place the hydrometer in the solution drum or in a separate container filled with the solution. The temperature of the solution should be taken together with the reading of the hydrometer (see Appendix 2).

the treating drum to make up for the evaporation. At the end of the heating period, the posts are allowed to cool in the solution, either by remaining in the treating drum or by being quickly removed to a drum of cold solution. On cooling, absorption of solution takes place, and there is much more water solution absorbed than creosote and oil under similar conditions. To make up for the solution absorbed by the posts, fresh solution is added from the solution storage drum, so that the treating liquid is kept up to the height of 2ft. 6in. marked on the drum.

If care is taken to add *water* to the treating drum to make up for the evaporation while the posts are being boiled, and if *solution* is added during the cooling and absorption period, the strength of the treating solution will remain fairly constant. (See Appendix 2.)

White arsenic is a poison, and every care should be taken while using it. (See Appendix 3.)

Sodium Fluoride and White Arsenic Solution.

Sodium fluoride and white arsenic are both bought in powder form.

In order to make 40 gallons of solution, the 45-gallon oil-drum is filled to a height of 2ft. 2in. with cold water. A mark should be made at this height. To the water 14½ lb. of sodium fluoride and 8½ lb. of white arsenic are added. The contents of the drum should then be heated to boiling and boiled vigorously for about 30 minutes or until all the chemicals have dissolved. (See instructions for zinc chloride and white arsenic solution.)

The treatment of posts, using the sodium fluoride and white arsenic solution, is exactly the same as for the zinc chloride and white arsenic solution, and the same instructions should be followed.

Schedules of Treatment.

With the species of timber tested in Western Australia, the schedules given in Tables 1 and 2 have been found to give the best results.

Table 1.—*Schedules for the Treatment of Round Fence Posts with Creosote and Oil Mixture.*

Timber.	Time of treatment.	
	Hot bath.	Cold bath.
	hours.	
Brown Mallet	4	Overnight
Gimlet	4	,,
Goldfields Redwood	4	,,
Jarrah	3	,,
Marrie (Red Gum)	4	,,
Morrell	4	,,
Salmon Gum	4	,,
Pinus radiata (*insignis*)	1½	3 hours

Table 2.—Schedules for the Treatment of Round Fence Posts with Water Solutions such as Zinc Chloride with White Arsenic and Sodium Fluoride with White Arsenic.

Timber.	Time of Treatment.	
	Hot bath.	Cold bath.
	hours.	
Boree	4	Overnight
Brown Mallet	3	"
Gimlet	4	"
Goldfield's Redwood	4	"
Jarrah	3	"
Marri (Red Gum)	2	"
Morrell	4	"
Salmon Gum	4	"
Pinus radiata (*insignis*)	2	"

Top Treatment of Fence Posts.

The treatments so far outlined have been for the butts of the posts only. In the case of wood of very low durability, it is often advisable to treat completely the whole length of the post, so as to prevent any possibility of decay or insect attack above the ground. With such untreated wood, decay is particularly liable to occur at the junction of fence rails or in the holes for the wire. Complete full-length treatment is not at present economically justified under Australian conditions, since the cost of treatment is considerable. If further information is required relative to the type of plant and costs, this can be obtained by reference to the Division of Forest Products.

For *Pinus radiata* (*insignis*) it appears that a light top treatment in conjunction with the butt treatment outlined previously will be justified. This can be done after butt treatment by inserting the posts top down in a drum of hot preservative and allowing them to stand in the hot oil for about five or ten minutes. For a post longer than 5 feet there will still be an untreated length, and this should be swabbed with hot preservative several times. Alternatively, the length above the treated butt could be brush-treated with hot preservatives.

Such top treatment is of value only so long as the thin layer of treated wood is kept unbroken. If posts are checked for rails or holes made for the wires, the untreated wood so exposed should be thoroughly brushed with preservative solution, which should be applied hot wherever possible.

9.—CARE OF TREATED TIMBER.

Butt-treated fence posts, if not intended for immediate use, should be carefully open piled in a similar manner to that detailed for seasoning, except that in this case the posts may be placed somewhat closer together in the layers. If this is not done, and the posts are bulk piled on the ground, there is considerable danger of decay or termite attack developing in the untreated tops, particularly in the case of non-durable timber.

Care should also be taken to ensure that the treated area of wood is not knocked off, thus exposing untreated material. Similarly, if it is necessary to cut into the treated zone in the construction of the fence line, all untreated timber so exposed should be brush-treated several times with preservative.

In the treatment of the post, provision was made for a preserved portion to remain above ground level, and when setting the posts, care should be taken that at least 6 inches of treated wood is exposed above the surface.

10.—COST OF TREATMENT.

The cost of treatment of fence posts will vary somewhat according to local conditions and to various items which, in some cases, may be considered directly chargeable to the treatment and, in others, not chargeable. The items of material and labour are listed below, and persons considering treatment can adjust their estimates of cost according to their conditions.

1. *Cost of Untreated Posts.*

Normally, on farms requiring considerable fencing, there are areas which are to be subsequently cleared, and which carry supplies of timber which can be made suitable for fence posts. Round posts are necessary for best results, and posts from about 3 inches to 6 inches diameter will be found satisfactory for use.* Actual costs of cutting, barking, and piling for seasoning in stacks close to the falling site averaged 25s. per 100 posts (labour at 16s. per day of eight hours) for experimental work in the eastern wheat belt. With experience in cutting and barking, these costs could be reduced to about £1 per 100; and in the case of post cutting and barking, in conjunction with clearing operations, the cost should be lower again. Generally, the time of barking is about equal to the time of felling and cutting to lengths. In the case of pines, the removal of the bark is more difficult, and the average cost per 100 barked posts would be about 25s.

2. *Cost of Plant.*

Forty-five gallon oil-drums are now common articles, and are available in almost all country centres. The average cost of drums suitable for treatment is at present about 4s. to 5s. each. A treating plant, consisting of two heating drums, two cooling drums, and a solution drum, would therefore cost about £1. The fire-places can generally be made from old iron, bricks, or stones, and to make them should not occupy more than an hour or two.

3. *Cost of Preservatives.*

The cost of preservatives varies somewhat according to market prices. The prices quoted hereunder are approximate only, and for Western Australia freight rates, as per Table 3, must be added to them.

Creosote.—Creosote varies considerably in price according to its grade and source of supply. A good grade creosote for wood-preserving purposes would cost about 1s. 9d. per gallon, f.o.r. Perth, in 45-gallon containers.

Fuel Oil—Fuel oil can be obtained at 5d. per gallon, f.o.r. Fremantle, in 45 gallon drums. The drums are returnable, but are charged for at the rate of 5s each. They would be suitable for treating drums.

Sodium Fluoride.—Sodium flouride in solid form will cost about 5d. per lb., f.o.r. Perth, in cwt. lots.

Zinc Chloride.—Zinc chloride in 50 to 55 per cent. solution will cost 3½d. per lb., f.o.r. Perth, in cwt. lots. It must be remembered that this solution only contains about half its weight of zinc chloride, so that the cost of the solution at the farm should be multipled by two to give the approximate cost of the pure zinc chloride.

White Arsenic.—The price of white arsenic is about 5d. per lb., f.o.r. Perth, in cwt. lots.

* If split posts are treated only the sapwood will be well penetrated. While, therefore, the treatment will not be as effective as with round posts, where the latter are unavailable, it will probably be justified.

Table 3.—Freight Rates on Preservatives, Western Australia.

Preservative.	Freight Rate. (Small quantities.)		
	100 miles.	200 miles.	300 miles.
Creosote	Per 45-gal. drum—about 10s.	Per 45-gal. drum—about 15s.	Per 45-gal. drum—about £1.
Crude Oil	Per 45-gal. drum—about 10s.	Per 45-gal. drum—about 15s.	Per 45-gal. drum—about £1.
Sodium fluoride ...	3s. 9d. per cwt.	5s. 6d. per cwt.	7s. 6d. per cwt.
Zinc chloride	5s. 6d. per cwt.	8s. 9d. per cwt.	12s. per cwt.
White arsenic	4s. 6d. per cwt.	7s. 6d. per cwt.	10s. per cwt.

Fuel.—The only charge for fuel on most farms will be the cost of collection. For two 4-hour boiling periods in the one day and the same drum, using water solutions, the amount of wood required would be, approximately, 1 cwt. to 1¼ cwt. For similar oil treatments the quantity would be considerably less. With firewood estimated at 6s. per ton for collection and cartage to the treating site the cost per day per two 4-hour treatments is about 4d. to 5d.

Labour.—The cost of labour for the treatment of fence posts as outlined above is difficult to estimate. Fence post treatment does not require continuous supervision. Once the solution has been heated, the posts inserted, and the correct treating temperature reached, only occasional firing and adjustment of solution levels is necessary. On a farm, therefore, a man treating posts can be doing other odd jobs at the same time. Also, it is possible that treating can be carried out at times when conditions are unsuitable for general farm work. If labour is employed continuously on fence post work, then the size of the treatment plant should be enlarged so that the labour cost per post is low.

11. ESTIMATED COST OF TREATED FENCE POSTS.

The cost of a treated fence post depends primarily on the cost of the untreated post, the cost of preservative and the amount of it absorbed by the post, the output of the plant and labour. In Tables 4 and 5 the estimated costs of treatment of posts of an average butt diameter of 4 inches are given. The times of treatment are based on those Tables 1 and 2, and it is assumed that there is a total of four drums for treatments.

A study of the tables shows that for treatment with creosote and fuel oil the items making up the cost of treatment are distributed in the order: Cost of preservative, cost of untreated posts, and labour. Where large numbers of posts are to be treated the cost of labour per 100 posts can be considerably lowered by increasing the number of treating drums.

In the case of treatment with water-soluble preservatives, the items making up the cost of treatment are distributed in the order: cost of untreated posts, labour, and cost of preservatives. Treatment with water-soluble preservatives costs less than with creosote and oil. Offset against the lower cost of treatment, however, is the fact that creosote and oil-treated posts will generally give longer life than posts treated with water-soluble preservatives, the latter materials being liable to be washed out of the wood by rain, drainage water, etc.

Table 4.—Estimated Cost of Treating with Creosote and Fuel Oil 100 Fence Posts, Average Butt diameter 4 Inches, Adding Freight for 200 Miles to Cost of Chemicals Used, and Using Four Drums for Treatments.

Species.	Average absorption per cubic foot of length treated.	Absorption of preservative per 100 posts.	Time of treatment.	Cost of barked untreated Costs.	Cost of preservatives absorbed.	Cost of treated posts excluding labour.*
	lb.	lb.	days.	£ s. d.	£ s. d.	£ s. d.
Brown Mallet	7·5	163·5	2	1 0 0	1 7 1	2 7 1
Gimlet	7·0	152·6	2	1 0 0	1 5 3	2 5 3
Goldfield's Redwood ...	5·0	109	2	1 0 0	0 18 1	1 18 1
Jarrah	6·0	130·8	1½	1 0 0	1 1 8	2 1 8
Marri (Red Gum) ...	7·0	152·6	2	1 0 0	1 5 3	2 5 3
Morrell	9·0	196·2	2	1 0 0	1 12 6	2 12 6
Salmon Gum	6·0	130·8	2	1 0 0	1 1 8	2 1 8
Pinus radiata	9·0	196·2	1	1 5 0	1 12 6	2 17 6

* NOTE.—When treatment can be carried out under favourable conditions and only the actual time of working on the treatment is chargeable, the estimated cost of labour at £3 15s. per week for brown mallet, gimlet, Goldfield's redwood, marri, morrell and salmon gum would be about 18s. per 100 posts, for jarrah about 14s. and *Pinus radiata* 10s. per 100. A small charge for firewood of about 1s. to 1s. 6d per 100 posts and any minor items should be added to the cost given under "Costs of treated posts."

Table 5.—Estimated Cost of Treating with Water-soluble Preservatives 100 Fence Posts, Average Butt Diameter 4 Inches, Adding Freight for 200 Miles to Cost of Chemicals Used, and Using Four Drums for Treatments.

Species.	Average absorption of solution per cubic foot of length treated.	Absorption of solution per 100 posts	Time of treatment	Cost of barked untreated posts.	Cost of preservatives absorbed.		Cost of treated posts excluding labour.*	
					Sodium fluoride and white arsenic	Zinc chloride and white arsenic.	Sodium fluoride with white arsenic	Zinc chloride with white arsenic
	lb.	lb.	days.	£ s d	s. d.	s. d.	£ s d	£ s d.
Brown Mallet ...	12	262	1½	1 0 0	6 10	9 3	1 6 10	1 9 3
Gimlet ...	9	196	2	1 0 0	5 1	7 0	1 5 1	1 7 0
Goldfield's Redwood ...	8·5	185	2	1 0 0	4 10	6 7	1 4 10	1 6 7
Jarrah	11	240	1½	1 0 0	6 3	8 6	1 6 3	1 8 6
Marri (Red Gum)	13	283	1	1 0 0	7 4	10 0	1 7 4	1 10 0
Morrell	12	262	2	1 0 0	6 10	9 3	1 6 10	1 9 3
Salmon Gum ...	10	218	2	1 0 0	5 8	7 9	1 5 8	1 7 9
Pinus radiata ...	11	240	1	1 5 0	6 3	8 6	1 11 3	1 13 6
Boree	7	153	2	1 0 0	4 0	5 5	1 4 0	1 5 5

* NOTE.—When treatment can be carried out under favourable conditions and only the actual time of working on the treatment is chargeable, the estimated cost of labour at £3 15s. per week for gimlet, Goldfield's redwood, morrell, salmon gum and boree would be about 18s. per 100 posts, for mallet and jarrah and about 14s. per 100 posts, and marri and *Pinus radiata* about 10s. per 100 posts. A small charge for fire wood of about 1s. to 1s. 6d. per 100 posts, a charge for carting water to the treating plant, and any minor items should be added to the cost given under "Costs of treated posts."

However, in the Eastern wheat belt, in rainfall areas below about 18 inches per annum, the factor of leaching becomes less important and the use of water-soluble preservative is recommended.

The estimates given in Tables 4 and 5 are a guide only, and in estimating his own costs a farmer should make allowance for the actual cost to him of presrvatives, untreated fence posts, and labour. If only a small number of posts are being treated, the total or a large proportion of the cost of the treating plant should be debited against the cost of the treatment. At the conclusion of the treatment there will remain on hand quantities of preservative solutions, which will be found to be of considerable value for brush-treating shed posts, gates, and other farm structures.

12. PROBABLE LIFE OF TREATED FENCE POSTS.

No data are available regarding the life of treated fence posts for the species of timber available for treatment in Western Australia. Experience with preserved fence posts in other countries, however, shows that properly-creosoted posts will give a life of at least 20 to 25 years. In dry localities, posts treated with water-soluble preservatives should give a life closely approximating this.

In conjunction with the Western Australian Forests Department, about 1,800 fence posts were treated with preservatives as set out in this publication. These posts have been installed in fence lines in three different localities in Western Australia, viz., Ghooli (near Southern Cross), Wickepin, and Pemberton. Frequent inspections of these lines will be made, and when the information is available details of results being obtained will be widely published in agricultural papers.

13. ECONOMY OF TREATMENT.

Although it is possible to increase the life of timber by preservative treatment, it is not economical to do so unless the cost of treatment is more than repaid by the increase in the life of the post. The cost for setting an untreated post is the same as for a treated post. If a treated post will last twice as long as an untreated one, then to the increased life of the treated post must also be added the cost that would have to be borne if the untreated post was removed and a new one put in its place. The best method of comparison therefore is to determine the annual service charge (cost per year of life) as distributed over the length of life of the post, assuming a constant charge for setting, compound interest at, say, 5 per cent. per annum, and no value for the eventually destroyed fence post. The costs per year of life of a post costing one shilling in place are given in Table 6.

Table 6.—Costs per Year of Life Posts Costing 1s. in Place. Compound Interest at 5 per cent.

Life in Years.	Annual Service Charge.	Life in Years.	Annual Service Charge.	Life in Years.	Annual Service Charge.
	s.		s.		s.
1	1·050	11	0·121	21	0·078
2	0·538	12	0·113	22	0·076
3	0·367	13	0·107	23	0·074
4	0·282	14	0·101	24	0·073
5	0·231	15	0·097	25	0·071
6	0·197	16	0·092	26	0·070
7	0·173	17	0·089	27	0·069
8	0·155	18	0·086	28	0·076
9	0·141	19	0·083	29	0·066
10	0·130	20	0·080	30	0·065

From Table 6, the cost per year of life for a post which cost 1s. 6d. to set, and which lasted ten years, would be 0.130 multiplied by 1½ equals 0.195 shillings, or about 2⅓d.

The following figures give an indication of the method for determining the economical value of treatment. The details of working are given in Appendix 4.

1. (a) For an untreated salmon gum post costing 2d. to cut and 1s. to set, and lasting seven years, the cost per year of life would be 0.202 shillings, or about 2½d.

(b) For a salmon gum post treated with creosote and fuel oil at a cost of 8d., plus 1s. to set, and lasting 20 years, the cost per year of life would be 0.133 shillings, or about 1½d.

(c) For a salmon gum post treated with sodium fluoride and white arsenic at a cost of 6d., plus 1s. to set, and lasting fifteen years, the cost per year of life would be 0.145 shillings, or about 1¾d.

The above figures show that both creosote with oil, and sodium fluoride with white arsenic treatments would result in a considerable saving over the use of untreated posts. For one post, this does not seem large, but if the results are considered for 1,000 posts the saving would be £3 9s. per year when using creosote with fuel oil, and £2 15s. per year when using sodium fluoride with white arsenic.

2. If a durable post costing 1s. on the farm, plus 1s. to set, lasts 30 years, the annual service charge would be 0.130 shillings. Creosote and oil-treated salmon gum posts, lasting 20 years, would have a cost per year of life of 0.133 shillings (see above). The difference is very small, and on account of the lower actual immediate outlay in money (£5 per 100 for naturally durable posts as against about £2 5s. per 100 for creosote and oil-treated salmon gum) the ordinary farmer would probably consider the treated salmon gum post as being the better for his purpose.

By estimating his own costs of treatment, by determining the probable cost per year of life on his posts, and by considering his initial outlay, a farmer can make his own decision on the advisability of treating and on the type of treatment.

14. CONCLUSIONS

The preservative treatment of fence posts means, in a large number of cases, a saving in first cost together with, in many cases, a reduced cost per year of life. It also makes available for use large quantities of timber which would otherwise be destroyed in clearing operations.

Three different types of preservatives are described for use with the open tank process and the choice of any one will depend on the cost, the availability of supplies, the location of use, and the estimated life or annual service charge. Creosote with fuel oils is better for use in wetter localities and treatment with this type of preservative is generally easier and simpler than with water-soluble preservatives. Either of the two types of water-soluble preservatives, *i.e.*, sodium fluoride with white arsenic or zinc chloride with white arsenic will give good service in drier localities, and the choice of these latter preservatives is a question of price and availability.

If information on source of supplies is required, inquiries should be addressed to the Conservator of Forests, Forests Department, Perth, or the Chief, Division of Forest Products, 314 Albert-street, East Melbourne.

The practice of preservation can likewise be extended to farm timbers other than fence posts, and the Division of Forest Products will gladly advise and assist farmers or other users of timber.

The Division would be grateful if those who have adopted the methods of treatment of this publication would forward details of the quantity and kind of posts treated, and of the preservatives used. This information will be of value in future years as a record of the advantages to be gained by preservative treatment.

APPENDIX 1.

Creosote Oil.

In this appendix, full details are given regarding the quality of creosote oil suitable for fence post treatments. If a user of oil is in doubt as to whether a grade of oil offered for sale is suitable he should state on his order that it must comply with the specification given below. It should not be necessary to do more than refer to this publication which will be forwarded to all known creosote producers in Australia.

In England, Europe, and the United States of America, creosote oils mostly used for wood preservation are horizontal retort oils and any such creosote oil conforming to the British Engineering Standards Association specification No. 144, 1921, or grades 1 and 2 of the American Wood Preservers' Association, is satisfactory for fence posts.

The bulk of Australian creosotes are produced from vertical retorts and they differ considerably from the horizontal retort oils. An investigation is now being undertaken to determine suitable specifications for these oils. Pending the completion of this, a tentative specification compiled from the results of the investigation to date, together with information collected from England, the United States of America, and New Zealand is suggested for use. This tentative specification is, of course, subject to modification after completion of the work. Vertical retort creosotes bought according to this specification should give complete satisfaction as fence post preservatives.

Tentative Specification for Australian Creosote Oils for Fence Post Preservation.

1. The oil shall be a distillate of coal tar and be free of any admixture of petroleum or similar oils. (In the case of ready-prepared creosote with oil mixtures the creosote used shall conform to the specification, and be in the proportion of at least 2 parts of creosote to 1 part of petroleum oil.)

2. The specific gravity of the oil at 38°C. compared with water at 15.5°C. shall be not less than 0.94.

3. The oil shall not contain more than 3 per cent. of water.

4. The oil shall not contain more than 0.5 per cent. of matter insoluble in benzol.

5. The distillate based on water-free oil shall be within the following limits:—

Up to 210°C. not more than 10 per cent.
Up to 235°C. not more than 35 per cent.
Up to 315°C. not more than 85 per cent.

6. The residue above 355°C. if it exceeds 5 per cent. shall have a float test of not more than 50 seconds at 70°C.

7. The amount of tar acids shall be not less than 5 per cent. by volume. There shall be no upper limit to the amount of tar acids.

The foregoing tests shall be made in accordance with the standard methods of the American Wood Preservers' Association. (Details of these methods will be supplied on application.)

APPENDIX 2.

Method of Controlling the Strength of Water Solutions.

It is very desirable that the strength of the treating solutions should be controlled. This can easily and conveniently be done by the use of a hydrometer, which is an instrument for determining the density or strength of solutions. A type recommended for use with the solutions of sodium fluoride with white arsenic and zinc chloride with white arsenic for the open tank process is one marked from 1,000 to 1,060, costing about 3s. 6d. to 4s. 6d. In use, it is simply placed in a long glass or tin of solution, and the point at which the liquid and the scale-marking coincide is noted. It will be found that the solution will be raised slightly around the glass stem of the hydrometer. The reading should be taken at the top of the raised surface against the hydrometer stem.

When using the hydrometer, the following simple precautions should be taken:—

1. The stem should be dry when it is used and it should be carefully inserted into the liquid so that the stem is not wet excessively.
2. The hydrometer should float freely in the solution and should not be in contact with the sides of the vessel when the reading is taken.
3. After use the hydrometer should be rinsed in clean water and dried.

As explained on page 24 the strength of the treating solutions can be roughly regulated by ensuring that during the boiling period, *water* is added to make up loss by evaporation, and during the cooling period, *solution* to make up for that absorbed by the posts. It is desirable that a closer control of the strength than is possible by this method is used. This can be very simply and conveniently done by using a hydrometer and a Fahrenheit thermometer.

When the fresh solution is prepared, a sample should be removed in a convenient vessel, allowed to cool, and the hydrometer reading taken together with the temperature. Whenever the strength of the treating solution is again determined, care should be taken that the temperature is not more than 5° Fahrenheit above or below that of the temperature of the fresh solution, as a larger difference in temperature affects the reading on the hydrometer. The strength of the fresh solution should be carefully recorded, as it is to be used for comparison with the treating solutions in use.

The strength of the fresh zinc chloride and white arsenic solution should be about 1050 at 60°F., 1049 at 70°F., and 1047 at 80°F., while the fresh sodium fluoride and white arsenic solution should be about 1053 at 60°F., 1051 at 70°F., and 1050 at 80°F. Commercial hydrometers vary somewhat, and it may be found that the strengths of the fresh solutions will differ from the figures given above by one to three points. Provided however, that the reading is carefully taken, the actual figure obtained does not matter.

If the treating solution is becoming weaker, it will be found that the hydrometer reading will be less than that for the fresh solution. For every point difference, one-half gallon of solution should be added during the **boiling period** to the treating drum (containing 25 gallons) to make up for some of the evaporation. For example, if the strength of the fresh solution at 70°F. is found to be 1049, and the strength of the solution being tested is 1043 at the same temperature, then the difference in the hydrometer readings is 6. Therefore, in order to increase the strength of the treating solution to normal, 6 multiplied by one-half, i.e., 3 gallons of solution, should be added to the 25 gallons of solution in the treating drum during the boiling period. The same method applies, whether the zinc chloride with white arsenic or sodium fluoride with white arsenic solutions are used.

If the strength of the treating solution becomes greater than that of the fresh solution it can be corrected by adding water directly to the treating drum. If the level in the treating drum is correct, a better way is to remove solution and replace it by water. For each point of the hydrometer reading greater than the recorded reading of the fresh solution, remove half-a-gallon of solution and replace it by half-a-gallon of water.

A kerosene or petrol tin holds 4 gallons of water or solution, and is a convenient measure for use. If the height of the tin is divided into eight equal parts, and these are clearly marked on the outside, each mark will represent, approximately, half-a-gallon of solution.

Tests of the strength of the water treating solutions should be made, if treatment is continuous, at least twice a week. More frequent determinations will give closer control of the strength of the solutions, but, if care is taken to follow the directions given, these are not thought to be necessary.

APPENDIX 3.

Precautions when using White Arsenic.

White arsenic is a poison, and care should be taken while using it. On no account should the powder or the solution be kept near food of any description. The precaution of thoroughly washing the hands after handling the solution or treated posts before handling food will prevent any trouble. If sores, open cuts, or abrasions are on the operator's hands, they should be kept well bandaged and out of contact with solution, as festering is likely to occur.

If by accident the white arsenic solution or powder is swallowed, vomiting should be brought about by taking a glass full of lukewarm water containing one tablespoon of salt or a dessert spoonful of mustard, or by tickling the throat with a feather. Drinks of milk, raw eggs and milk, olive oil, or strong tea should be taken afterwards. If necessary medical advice should be obtained.

APPENDIX 4.

Economy of Treatment—Details of Calculations.

The figures in Table 6, giving the cost per year of life of posts costing 1s. in place, compound interest at 5 per cent., were obtained from the formula—

$$\text{Cost per year of life} = \frac{CR\,(1+R)^n}{(1+R)^n - 1}$$

where C = final cost of post in place,
R = rate of interest (5 per cent. = 0.05),
n = life of posts in years.

By using this formula, the figures in Table 6 can be extended beyond the period of 30 years if so desired.

Details of working—	s.	d.	
1. (a) Cost of cutting salmon gum post	0	2	
Cost of setting	1	0	
Total cost of untreated post in fence	1	2	
Estimated life of untreated post			7 years.
Cost per year of life = 0.173 (from Table 6) multiplied by $1\frac{1}{6}$ shillings = 0.202 shillings, or about $2\frac{1}{2}$d.			
(b) Cost of cutting, seasoning, and treating salmon gum post with creosote and fuel oil	0	8	
Cost of setting	1	0	
Total cost of treated post in fence	1	8	
Estimated life of treated post			20 years.
Cost per year of life = 0.080 (from Table 6) multiplied by $1\frac{2}{3}$ shillings = 0.133 shillings, or about $1\frac{1}{2}$d.			
(c) Cost of cutting, seasoning, and treating salmon gum post with sodium fluoride and white arsenic ..	0	6	
Cost of setting	1	0	
Total cost of treated post in fence	1	6	
Cost per year of life = 0.097 (from Table 6) multiplied by $1\frac{1}{2}$ shillings = 0.145 shillings, or about $1\frac{3}{4}$d.			
2. Cost of durable post	1	0	
Cost of setting	1	0	
Total cost of durable post in fence	2	0	
Estimated life of durable post			30 years.
Cost per year of life = 0.065 (from Table 6) multiplied by 2 shillings = 0.130 shillings or about $1\frac{1}{2}$d.			

HOME FELLMONGERING METHODS.

HOW TO REMOVE THE WOOL.

Hugh McCallum.

The cleaning of the wool from sheepskins is known as "fellmongering."

Dry skins are those taken off the sheep carcase, and then dried and stored. Green skins are those from freshly slaughtered sheep. "Pelt" is the name given to the skin after the wool has been pulled or taken off. "Slipe" is the pulled wool that has been dried and not scoured. "Skin wool" is pulled wool which has been scoured and dried. "Plucked wool" is that plucked from a sheep that has been dead for a few days. "Fallen" or "dead" wool is that taken off the remains of a sheep which have been dead for a considerable time.

Fellmongering is usually undertaken by a special firm, and the object is to remove all wool from the skins, leaving the pelt uninjured and the wool in its natural state. The firms undertaking this work have special processes, one of which includes the use of lime, but these might not prove satisfactory at the hands of an amateur. For farm or station use the general procedure is:—

(a) Soften the skins by soaking;
(b) Sweat the skins to loosen the wool;
(c) Pull or push off the wool;
(d) Dry the wool;
(e) Stretch and dry skins, and tan if required.

Skins should be prepared by cutting off feet, face skin, hocks and ears, as these portions tend to heat quicker than the balance of the skin and may blacken in the sweating. They will quickly discolour other wool with which they may have come in contact.

Skins should be soaked until well softened, probably one to three days, then drained for about twelve hours.

They are then spread out on a flat piece of ground or shed floor, which has been covered with bagging, taking care to turn the skirts and points under so that they attract the heat sooner than the outside parts; pack skins one on top of the other, then cover with bags or sheets to keep the warm moist air in and prevent and cold air penetrating the heap. In warm, close weather, the skins will require to be reversed after sweating from 16 to 20 hours, but in cold weather they may require up to two days.

Examine from time to time, taking care not to permit too much cold air to reach the heap, and test for loosening of the wool. As the wool commences to leave the skin, take each skin out and spread on a log or board, and pull or push off the wool, using a blunt instrument. Clean boards or bags should be spread round and the wool placed on same. The wool from the back, sides, and shoulders should be first removed and placed in a separate heap, being classed as "firsts"; the edges of the skin are next treated, and the wool classed as "seconds" are short; bitty trimmings are then removed and put into "thirds."

The wool must not be permitted to remain in heaps for, being wet, it will soon heat.

If it is not intended to scour it immediately, it must be spread out on bags or wire racks to dry. When thoroughly dried the wool can be pressed and bailed.

If the skins are required for use, they should be stretched out to dry, the same as when taken off green, and they can afterwards be tanned and used for many odd purposes on the farm.

DROOPING FLOWERED CLOVER SEED.

G. R. W. MEADLY, B.Sc., Agricultural Adviser.

Drooping Flowered Clover (*Trifolium cernuum*) is native to Spain and the Mediterranean Region, and according to old residents has been known to occur in Western Australia for at least twenty-five years. It was originally noted at Gingin, hence the early name of "Gingin Clover," and has now become one of our most important clovers, being widely distributed throughout the South-West, South Coastal, and Great Southern Districts.

As it is not grown to any extent in the other States, farmers are dependent upon locally-produced seed, which largely comes from the Harvey, Boyanup, Busselton, and Capel districts. The production last year was in the vicinity of 7,500 lbs., with an approximate value of £1,000, but unfortunately during that season the "hard seed" content of the clover was phenomenally high.

The majority of leguminous plants produce a certain number of so-called "hard seeds" which are viable, but do not readily germinate. After the germination of the normal seeds these "hard seeds" produce seedlings at intervals, and some may still be viable yet not germinated after a period of years. This feature is of most importance locally in connection with Lupins, Subterranean, Cluster, and Drooping Flowered Clovers.

Under certain circumstances "hard seeds" must be regarded as an asset, for once an annual clover is established, their presence, to a reasonable extent, is of value for ensuring a stand each year. Early rains followed by a dry period may germinate the ordinary seeds produced by the seeding down of the previous year's crop, only to kill most of the young seedlings. Under such circumstances some of the "hard seeds," the germination of which has been retarded, produce at a more seasonable period seedlings which comprise entirely, or increase considerably, the stand of the clover.

At the time of original planting, however, when the actual date of sowing can be regulated to suit the conditions prevailing that season, the presence of a large percentage of "hard seeds" must be considered detrimental, at least for the first season's crop.

The following table gives the purity, germination, and "hard seed" content for Drooping Flowered Clover during the last three years:—

Year.	Pure Seeds.	Impurities.	Weed Seeds.	Germination.	Hard Seeds.
	%	%	%	%	%
1929-30	69·2	23·3	7·4	31	66
1930-31	79·0	12·4	8·6	39	60
1931-32	90·8	6·2	2·3	6	94

The purity of the seed produced has improved from year to year, but, as mentioned previously, the germination in 1931-32 was very low, due to the high percentage of "hard seeds" which was probably caused by the unusually dry conditions existing during the ripening period. Fortunately, by scarifying this type of seed the germination can be increased considerably. Experiments recorded in the June issue of this Journal show that by means of the scarifying machine employed, seed of Drooping Flowered Clover normally giving a germination of under per cent. may have its germination raised to above 40 per cent.

When purchasing seed an important phase, apart from the germination, is the purity, particularly the absence of serious weed seeds. In one line of Drooping Flowered Clover seed tested the impurity figure was 57.6 per cent., and 47.6 per cent. of the total weight was composed of sand. As this line also contained 2.8 per cent. weed seeds, and gave a germination of 23 per cent., its actual value was very low. The foreign seeds present may be conveniently classed into two groups, weed seeds, *e.g.*, Sorrell, Flatweed, and other crop seeds, *e.g.*, Cluster Clover, Rye Grass.

The following are notes on Drooping Flowered Clover and its main seed impurities:—

Drooping Flowered Clover (Trifolium cernuum).—This is one of the most important annual clovers in this State, and is particularly suited to ground which retains its moisture well into the summer. It will withstand considerable inundation during the winter months, and hence will grow in much wetter situations than Subterranean Clover.

The seed is yellow and very small, being about 1.3 mm. long by 1 mm. wide (Fig. 1), and one pound contains approximately 1,300,000 seeds. Drooping Flowered Clover should be planted in autumn, and sown at the rate of 4 lbs. per acre if of average purity and germination. When sown in mixtures the amount depends upon the other constituents of the mixture.

Cluster Clover (Trifolium glomeratum).—As a leguminous fodder plant for the drier areas this clover is outstanding, but when contained in Drooping Flowered Clover seed is of comparatively little value owing to the conditions usually existing where the latter is grown. The seeds (Fig. 2) very closely resembles that of Drooping Flowered Clover, but is slightly wider in comparison with its length, and the radicle (right portion of seed in drawing) usually doubles back further along the remainder of the seed. It is very difficult, however, to definitely separate the two, and in any case the most harm the presence of Cluster Clover can do is to reduce the amount of Drooping Flowered Clover in the seed obtained.

Woolly Clover (Trifolium tomentosum).—This clover is worthy of encouragement in the Wheat Belt, but must be regarded as more or less a weed under the favourable condidtions existing where Drooping Flowered Clover thrives. The seed (Fig. 3) is reddish-yellow in colour with a mottling of dark green, and has a very prominent radicle.

Hop Clover (Trifolium agrarium).—An annual clover often found as a weed in lawns, and of little value in good pastures. The seed (Fig. 4) is comparatively long for its breadth, shiny and ranging in colour from a light yellow to a brown.

Suckling Clover (Trifolium dubium).—This is a prostrate annual sold as a pasture plant, but of minor importance. It is a common garden weed, being particularly troublesome in lawns. The seed (Fig. 5) is smooth and shiny, varying in colour from a light to a dark brown.

Barley Grass (Hordeum murinum).—For early feed this grass is of value, but must be regarded as a weed in permanent pastures. When dry the "seeds" are often troublesome to sheep, becoming tangled in the wool and also irritating the mouth and other parts. The name "Spear Grass" is often applied, but this should be confined to members of the genus *Stipa*. The usual form in which Barley Grass is found as an impurity is shown in Fig. 6. Here the spikelets are grouped into three, only the centre one producing a seed, the other two being sterile.

Silver Grasses (Festuca spp.).—Several species of Silver Grass are found as impurities, but the most common one is *F. bromoides* (Fig. 7). These grasses

have little value, and under favourable conditions should certainly be discouraged. In *F. bromoides* the flowering glume is about 7mm. long, rounded on the back and with an awn as long as itself.

Annual Brome Grasses (Bromus spp.).—Large Brome (*B. villosus*), Madrid Brome (*B. madritensis*), and Soft Brome (*B. hordeaceous*) (Fig. 8) are most frequently present. Like the Silver Grass they have some value in places which are unfavourable for the growth of better fodder grasses, but are harmful in permanent pastures. The flowering glume of *B. hordeaceous* is about 7 mm. long, keeled on the back, and with an awn half its length.

Yellow Weed (Bartsia viscosa).—This is the most serious weed yet found in samples of Drooping Flowered Clover seed, and is included in the list of Noxious Weed Seeds. It is a very free seeding annual which has taken possession of certain areas in the South-West. Unfortunately all seed which is sold direct from one farmer to another cannot be inspected, so buyers should be particularly careful when purchasing to make certain that this weed seed is not present. If any doubt exists, a sample should be forwarded to the Department for examination. The seed (Fig. 9) is brown in colour with indistinct markings and very small, measuring only about ½ mm. long by ¼ mm. wide (*i.e.*, approximately one-fiftieth and one-hundredth inch). ,

Catchfly (Silene gallica).—An annual weed belonging to the Carnation family and fairly widely distributed throughout the State. The seeds are dark, roughened, and somewhat kidney-shaped.

Flat Weeds (Hypochoeris spp.).—Two species are found locally, *H. glabra* and *H. radicata* (Fig. 11). They are most troublesome in lawns, as they die in summer and produce bare patches. Normally these "seeds" have a ring of hairs at the end to aid wind dispersal, but usually when present in seed samples this has been broken off. The "seeds" of the two species are very similar, being brown in colour with a roughened surface.

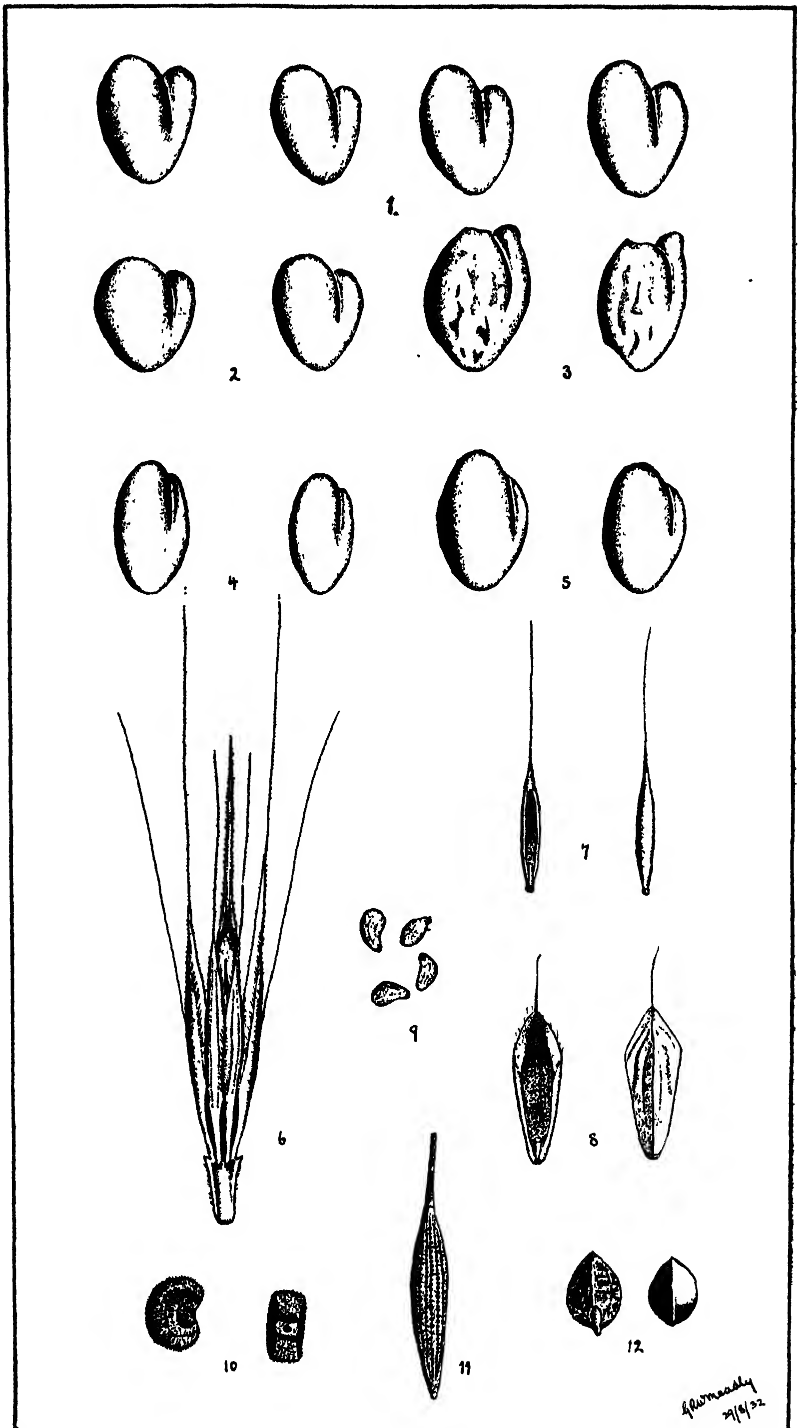
Sorrel (Rumex acetosella).—Sorrel is a common weed, particularly in damp and sour situations. It is a difficult plant to eradicate, but drainage, cultivation, and the growing of a smother crop are valuable factors in its control. The seed may be present either bare or with a rough reddish coating as shown in Fig. 12.

Other foreign seeds found in samples of Drooping Flowered Clover Seed include Fairy Grass (*Aira caryophyllea*), Yorkshire Fog (*Holcus lanatus*), Perennial Rye Grass (*Lolium perenne*), Timothy (*Phleum pratense*), and Toadrush (*Juncus spp*).

EXPLANATION OF PLATE.

Seeds of—

1. Drooping Flowered Clover (*Trifolium cernuum*) × 13.
2. Cluster Clover (*Trifolium glomeratum*) × 13.
3. Woolly Clover (*Trifolium tomentosum*) × 13.
4. Hop Clover (*Trifolium agrarium*) × 13.
5. Suckling Clover (*Trifolium dubium*) × 13.
6. Barley Grass (*Hordeum murinum*) × 2.
7. Silver Grass (*Festuca bromoides*) × 3.
8. Soft Brome Grass (*Bromus hordesaceous*) × 3.
9. Yellow Weed (*Bartsia viscosa*) × 10.
10. Catchfly (*Silene gallica*) × 9.
11. Flat Weed (*Hypochoeris radicata*) × 4.
12. Sorrel (*Rumex acetosella*) × 10.



Drooping Flowered Clover Seed.

HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION TESTING SCHEME.

Conducted by Dairy Branch, Department of Agriculture, Western Australia, Year ending 30th June, 1932.

Name of Cow.	Breed.	Herd Book No	Date of Birth	Date of Calving	No. of days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Butter Fat.	Owner.	Sire.
MATURE COWS (OVER 5 YEARS OLD)—STANDARD 350 LBS. BUTTER FAT.											
						lb	lb	%	lb.		
East View Lucky Pretty Maid 3rd	A.I S	8481	2-11-24	10-3-31	273	40½	13,921	4·0	557·63	A E Grant ..	East View Lucky Boy, 593
Koojan Dame ...	Guernsey	1252	18-6-24	22-4-31	273	33½	13.000	4·02	522 78	Denmark Stud Farm	Robin of Nundorah, 417
Darbalara Melba 69th	A I.S.	..	6-11-24	10-8-31	273	26	10,668	4 54	499·37	W. G. Burgess	Re-echo of Darbalara
Darbalara Melba 42nd	do.	...	26-8-21	1-7-31	273	23½	11 245	4 39	492 27	do	Limelight of Darbalara
Claremont Belle 4th	do.	..	26-4-24	3-7-31	273	14½	11 353	4 22	472·31	Claremont Hospital for Insane	Claremont Telyarup Prince, 2352
Hope 3rd of The Hill ..	do.	.	6-1-25	13-6-31	273	16½	11.059	4·12	453 92	W. G. Burgess	Crescent of the Hill, 2016
Kurrawong Katheleen 5th	do.	.	13-12-25	5-7-31	273	15	10,755	4·07	438 14	do.	Kurrawong Premier, 1212
Primrose (foundation cow)	do.	..	1924	14-9-31	273	22	9,591	4·45	427 25	D. Bevan	Triumph of Berry
Claremont Maggie ...	do.	...	12-3-26	5-9-31	273	14½	11 293	3·76	425 81	Claremont Hospital for Insane	Sunnyvale Searchlight, 2302
Greenmount Charming Bells	Jersey	17987	18-7-24	27-9-31	273	16	7.623	5·46	415 16	A. J. B. Strempel	Werribee Starbrights King, 2602
Banyule Silvermine 38th ...	do	18817	19-10-25	31-7-31	273	19½	7.640	5·41	413 16	Sabina Vale Stud Farm	Wotton Airman (imp.), 2716
Grassvale Lady Fowler 3rd ...	do.	19111	20-5-25	4-7-31	240	20	8.160	5 07	406·47	R. H. Rose	Rye Duke of Glen Iris, 1994
Daphne 7th of the Hill	A.I.S.	...	15-5-26	4-10-31	273	34	9,267	4 36	404·87	W. G. Burgess	Crescent of the Hill, 2016
Minnamurra Holly ...	Guernsey	953	5-1-23	29-4-31	273	19	8,367	4·80	404 45	Muresk Agricultural College	Minnamurra Favourite Prince 294
Grassvale Starbrights Daisy	Jersey	20873	24-8-25	15-10-30	273	20½	10,007	3 97	397 89	C. H. Ironmonger	Starbright's Sweet Duke of Glen Iris, 3710
Claremont Mabel 2nd ..	A.I.S.	...	1-6-26	5-9-31	273	35½	9 991	3 95	394 93	Claremont Hospital for Insane	Claremont Telyarup Prince
Raleigh Ethel 13th ...	A.I.S.	..	9-9-26	24-9-31	273	25	9,090	4 37	395 44	D. Bevan	Raleigh Barrister
Kurrawong Pride 4th ..	do	...	17-11-25	6-6-31	273	23	10,109	3 85	390 20	W G. Burgess	Premier of Kurrawong, 1212
Juadine Juliet 2nd	Jersey	20911	18-8-25	14-11-30	273	22	6 426	6·07	389 31	Miss Hancock	Garden Hill Fascinator, 2754
Ventonia Buttercup ...	do.	12827	30-5-22	28-6-31	273	14½	7 123	5 55	388 89	R. H. Rose ...	Ingot of Banyule, 1413
Lonswood Lady Grey	do.	17951	18-6-24	19-10-30	273	16	8 058	4 77	384·74	A J B. Strempel	Lord Fowler of Dardanup, 4016
Greenmount Gay Lady ...	do.	20904	20-3-25	2-6-31	273	18	6 729	5 69	382 10	do.	Werribee Starbright's King, 2602
Moorlands Lydia	do.	19107	22-12-24	27-4-31	240	19½	7,890	4·76	375·75	P Rose	Roelands Topnotch, 4011
Greenmount Bo-Peep ...	do.	20902	24-6-25	17-5-31	273	22	7 206	5·15	370·65	A J. B. Strempel ..	Werribee Starbright's King, 2602
Sparkle of Trelawny ...	do	20914	16-5-24	15-9-31	273	21	7,458	4 94	369 55	Miss Hancock	Trelawny, 3436
Denmark Anne ...	Guernsey	1164	2-3-25	17-6-31	273	17	7,596	4·83	367·59	Denmark State Farm	Lenwood of Wollongbar, 381
Grassvale Jess ...	Jersey	20872	5-8-25	14-10-30	273	19	8 247	4 45	364 94	C H Ironmonger	Starbright's Sweet Duke of Glen Iris, 3710
Roelands Bright Lass ...	do.	14322	3-2-22	24-2-31	273	22	6 996	5 2	353·60	W. Hull	Makarini, 995
Grassvale Golden Cream 2nd ...	do	24926	23-4-26	14-8-31	273	26	6,648	5·23	348 23	R H Rose ..	Rye Duke of Glen Iris, 1994

Wollongbar Dessie 2nd	Guernsey	1121	21-5-24	12-8-31	273	17	6,426	5·19	332·08	Muresk Agricultural College	Renown of Wollongbar, 415
Waterside Sunlight ...	A.I.S.	...	25-10-22	21-8-31	273	10	6,990	4·75	331·35	Wooroloo Sanatorium	Masher of Mayfield, 1135
Kurrawong Royal Lady ...	do.	..	6-4-25	10-2-31	210	27	7,740	4·07	314·76	W. G. Burgess	Count Hughes of Cosey Camp, 2011
Spurfield Alma	Guernsey	1049	14-11-24	21-6-31	273	15	6,465	4·78	308·97	Muresk Agricultural College	Miltons Steadfast, 292
Denmark Rosa	do.	1429	15-12-25	28-8-31	273	15	5,760	5·31	305·71	Denmark State Farm	Rose Chief of Wollongbar, 130
Capel Lass	Jersey	24,905	1-8-25	12-4-31	273	20½	6,936	4·39	302·92	B. W. Prowse	Brown Fern of Glen Iris, 1364
Wollongbar Golden Pearl 5th ...	Guernsey	1,128	8-9-24	14-9-31	273	14	5,412	5·55	299·98	Muresk College	Wollongbar Judge, 184
* Nooka Queen	Jersey	23,664	16-1-26	3-5-31	273	18	5,914	5·00	297·00	S. P. Herbert	Jessie King of Sarnia, 4678
Blanche 5th of Minathorpe ..	A.I.S.	...	16-5-26	27-8-31	273	14	7,572	3·87	294·21	R. Bee	Collier of Darbalara
Moorlands Gwen	Jersey	20,890	13-10-25	25-8-31	273	13½	5,275	5·33	279·83	P. Rose	Colonel of Melrose, 4015
Nooka Vanity	do	23,665	16-5-25	27-4-31	273	14	5,097	5·48	274·33	S. P. Herbert	White Prince of Roelands, 3153
Minnamurra Fairy Queen ..	Guernsey	1,592	1-6-26	11-7-31	210	18	5,115	5·35	267·06	Giblett & Johnston	Minnamurra Golden Lad, 402
Dinah 2nd of Wollongbar	do	832	13-2-22	11-10-30	240	18	5,940	4·47	265·77	Denmark State Farm	Wollongbar Judge, 184
Wollongbar Gladness 2nd	do	631	10-5-21	30-11-30	273	10	5,085	5·10	261·34	do	Faithful Fido of Wollongbar, 81
Golden Noble Princess of Glen Iris	Jersey	12,965	25-8-22	13-5-31	240	9	4,290	5·8	248·92	W. Padbury	Mercede's Prince of Glen Iris 1917
Wollongbar Realm 2nd...	Guernsey	1,151	22-11-23	12-8-31	210	14	6,385	4·63	249·84	Muresk Agricultural College	Wollongbar Bellman, 334
Hamel Lea Pit-a-Pat . .	Jersey	20870	20-10-25	21-3-31	240	11	4,800	5·14	246·72	W. Hull	Bracken Chief of Hamel Lea, 2783
Blanche 4th of Minathorpe ..	A.I.S.		16-7-25	1-9-31	240	7	6,255	4·08	245·43	R. Bee	Collier of Darbalara
Mokine Heroine 3rd . .	Jersey	24948	28-7-26	24-9-31	273	15	5,385	4·44	238·84	T. H. Wilding	Mokine The Hood
Wollongbar Velvet .	Guernsey	774	16-5-20	11-12-30	273	15½	5,701	4·03	230·96	Denmark State Farm	Faithful Fido of Wollongbar, 81
Lingclea Fancy	Jersey	6674	29-9-17	13-8-31	180	19½	5,035	..	223·56	W. Hull	Retford Mariposa, 896
Tessie of Garden Hill . .	do	17957	28-9-24	31-8-31	150	23	4,215	5·29	222·24	W. Padbury	Cream Socks of Glen Iris, 1410
Hamel Lea Bracken's Fancy ..	do	20867	24-7-24	8-6-31	240	16½	4,680	4·72	220·71	W. Hull	Bracken Chief of Hamel Lea, 2783
Noraleda 3rd of Roelands .	do	14338	19-2-23	22-3-31	240	8½	4,290	4·9	212·25	do	Brown Fern of Glen Iris, 1364
Waterside Rose	A.I.S.	.	28-7-22	29-9-31	120	27	4,350	4·49	193·50	Wooroloo State Farm	Premier of Mayfield, 511
Wollongbar Parsons Red Rose 31st	Guernsey	985	21-11-22	11-3-31	273	11	3,633	5·3	183·56	Denmark State Farm	Rose Boy of Wollongbar, 316
Pansy 2nd (foundation cow) .	A.I.S.	.	0-0-24	5-7-31	180	11	4,095	4·1	168·51	D. Bevan	Premier of Blackheath
Grassvale Lady Fowler 6th .	Jersey	24928	20-6-26	2-7-31	90	22	2,205	5·2	116·07	R. H. Rose	Carnation's Masterpiece of Garden Hill, 206
Grassvale Sweet Duchess . .	do	23692	9-9-25	13-7-31	60	27½	1,725	5·2	90·96	R. H. Rose .	Starbright's Sweet Duke of Glen Iris, 3710
Moorland's Bloom . .	do	20887	4-6-25	6-6-31	30	32	960	4·6	43·80	P. Rose ..	Grafter of Melrose, 3560

COWS OVER 4½ YEARS AND UNDER 5 YEARS—STANDARD 330 LBS. BUTTER FAT.

Gold of East View ..	A.I.S.	10940	1-5-26	14-1-31	273	25	12,675	4·01	508·73	W. G. Burgess	Mariner of Greyleigh, 587
Moorlands Ada	Jersey	23679	25-5-26	17-4-31	273	13	8,454	5·05	465·01	P. Rose .	Colonel of Melrose, 4015
Dahlia 4th of Raleigh	A.I.S.	..	2-12-26	16-7-31	273	28	11,994	3·82	457·98	D. Bevan . .	Union Jack of Raleigh 2375
Claremont Molly 5th .	do.	..	21-3-27	11-9-31	273	33½	11,185	4·07	455·09	Claremont Hospital for Insane	Searchlight of Sunnyvale
Moorlands April . .	Jersey	23687	3-9-26	10-6-31	273	16	7,908	5·46	431·24	P. Rose .	Colonel of Melrose, 4015
Koojan Bonnie Jean .	Guernsey	1612	28-3-26	13-2-31	273	16½	7,385	5·70	423·81	A. W. Padbury	Robin of Nundorah 417
Koojan Ida	do	1900	3-2-27	15-9-31	273	26	7,403	5·40	409·49	do	Robin of Nundorah, 417
Greenmount Charming Bells 2nd	Jersey	23708	12-3-26	27-11-30	273	16	6,453	6·05	390·64	A. J. B. Stiempel	Cheer Up of Hamel Lea, 4307
Pet 5th of Kurrawong . .	A.I.S.	.	2-8-26	10-7-31	273	17	9,696	4·03	389·87	A. E. Grant	Premier of Kurrawong
Nooka Iris ..	Jersey	23662	25-5-26	27-11-30	273	25	7,350	5·29	388·82	S. P. Herbert	Jessies King of Sarnia, 4578
Venus 7th of Raleigh . .	A.I.S.	.	3-10-26	12-6-31	273	29	10,182	3·70	378·39	D. Bevan . .	Union Jack of Raleigh, 2375

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of days in Test.	Weight of Milk last day of Test	Weight of Milk for period.	Average Test.	Butter Fat	Owner.	Sire.
COWS OVER 4½ YEARS AND UNDER 5 YEARS—STANDARD 330 LBS BUTTER FAT—*continued.*											
						lb.	lb	%	lb		
Diamond 3rd of Raleigh	A.I.S.	..	19-11-26	13-9-31	273	27	9,726	3·78	366·85	D Bevan	Union Jack of Raleigh, 2375
Moorlands Olive	Jersey	26383	16-7-26	30-6-21	273	14½	8,698	4·12	358·86	P. Rose	Colonel of Melrose, 4015
Lonswood Lady Grey 4th	do.	23700	11-9-26	4-9-31	273	21½	7,474	4·79	357·44	B. W. Prowse	Hamel Lea Bracken Chief, 2783
Wollongbar Betty 2nd	Guernsey	1571	4-7-26	23-5-31	273	14	6,447	5·41	348·90	Muresk Agricultural College	Bounty of Wollongbar, 336
Minnamurra Orvieto	do.	1597	4-8-26	11-4-31	273	18	5,989	5·77	344·35	Giblett & Johnston	Minnamurra Golden Lad, 402
Gold X. of Raleigh	A.I.S.	..	15-11-26	14-7-31	273	18	8,394	3·99	330·07	D. Bevan	Pacific of Raleigh, 1731
Elsie 4th of Raleigh	do.	...	24-1-27	19-8-31	273	24½	8,488	3·68	312·48	do.	Union Jack of Raleigh
Wooraloo Pride 2nd	do	15146	21-7-26	3-4-31	180	24½	4,710	4·3	206·34	Wooroloo State Farm	Commercial of Blackheath
Minnamurra Joyce	Guernsey	1866	14-10-26	23-9-31	150	25	4,365	4·3	190·05	Giblett & Johnston	Minnamurra Golden Lad, 402
Koojan Jess	do.	1570	14-7-26	28-1-31	210	14	3,120	5·1	161·13	Denmark State Farm	Koojan Golden Governor, 595
Lupin 2nd of Claremont	A.I.S.	..	27-7-26	19-3-31	240	5½	3,885	3·8	150·81	Baily Bros.	Searchlight of Sunnyvale, 2302
COWS OVER 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LBS. BUTTER FAT.											
Kitty 8th of Kurrawong	A.I.S.	...	6-8-26	1-2-31	273	18	9,114	4·7	423·00	W. G. Burgess	Premier of Kurrawong, 1212
Moorlands Biddy	Jersey	24915	10-5-27	8-7-31	273	14½	7,662	5·47	419·12	P. Rose	Colonel of Melrose, 4015
Nancy 9th of Raleigh	A.I.S.	..	30-4-27	17-7-31	273	23	9,084	4·58	416·92	D. Bevan	Union Jack of Raleigh, 2375
Moorland's Bridget	Jersey	24920	1-7-27	13-7-31	273	12	7,831	4·99	382·37	P Rose	Colonel of Melrose, 4015
Grassvale Montrose Maid	do	24929	8-6-27	14-9-31	273	24	7,332	5·0	365·72	R H Rose	Montrose East of Glen Iris, 4140
Grangelea Buttercup	do.	26388	21-3-27	19-7-31	273	21	6,948	4·9	344·89	Sabina Vale Stud Farm	Grangeleas Dairy V C., 5079
Moorland's Bebe	do	24912	21-4-27	30-6-31	273	11½	7,594	4·5	343·71	P. Rose	Grafter of Melrose, 3560
Pentland Blossom 5th of Claremont	A.I.S.	15070	2-5-27	7-5-31	273	19½	8,683	3·8	341·65	Claremont Hospital for Insane	Telyarup Prince of Claremont, 2352
Muresk Buttercup	Guernsey	1799	19-4-27	6-9-31	273	19½	6,073	5·3	322·09	Muresk Agricultural College	Triumph of Wollongbar, 513
Muresk Carnation	do.	1800	3-5-27	22-8-31	273	17	6,531	4·92	321·46	do	Triumph of Wollongbar, 513
Juadine Sparkle	Jersey	24716	12-8-26	10-6-31	273	11	6,663	4·73	315·01	Miss Hancock	Juadine Fop, 5797
Denmark Rosa 2nd	Guernsey	1793	6-2-27	18-4-31	273	12½	5,497	5·38	295·97	Denmark State Farm	Rose Chief of Wollongbar, 130
Moorland's Brenda	Jersey	24919	10-7-27	23-7-31	273	9½	6,448	4·44	286·49	P Rose	Grafter of Melrose, 3560
Minnamurra Judy	Guernsey	1868	4-4-27	21-7-31	210	15	4,905	5·6	276·66	Giblett & Johnston	Judge of Wollongbar, 184
Minnamurra Millicent	do	1872	28-10-26	13-3-31	273	11	4,463	4·82	215·36	Giblett & Johnston	Minnamurra Golden Lad, 402
Rosemont Lady 4th	A.I.S.	14970	18-8-27	30-11-31	150	25	4,815	4·3	208·59	W. G Burgess	Crescent of the Hill, 2016
Claremont Lucy 3rd	do.	.	12-7-27	22-9-31	150	22	4,230	4·15	175·92	Claremont Hospital for Insane	Telyarup Prince of Claremont, 2352
Minathorpe Carnation 2nd	do.	.	8-5-27	2-11-31	120	19	3,615	3·7	136·20	R. Bee	Collier of Darbalara
Grassvale Montrose Nora	Jersey	24930	19-7-27	30-8-31	60	21	1,440	5·37	77·20	R. H. Rose	Montrose East of Glen Iris, 4140
Denmark Rose Lady	Guernsey	1795	22-8-27	6-12-31	60	21	1,425	4·59	64·36	Denmark State Farm	Rose Chief of Wollongbar, 130

COWS OVER 3½ YEARS AND UNDER 4 YEARS.—STANDARD 290 LBS. BUTTER FAT.

Sally of the Hill	A.I.S.		8-10-27	30-6-31	273	15½	1,011	4 23	465 79	W. G. Burges	Crescent of the Hill, 2016
Koojan Bonny Elizabeth	Guernsey	1899	23-3-27	28-1-31	273	24	7,077	5·88	411 77	A. W. Padbury	Robin of Nundorah, 417
Koojan Mordern Lady 5th	do.	1902	17-3-27	22-1-31	273	24½	7,424	5 22	387 54	do.	Koojan Golden Governor
Limelights' Camelia of Wangara	A.I.S.		24-7-27	26-2-31	273	31	9,273	4·1	381 04	W. G. Burges	Limelight of Darbalara
Denmark Rose Dame	Guernsey	1794	19-8-27	19-7-31	273	11	8 508	4 35	369 86	Denmark State Farm	Rose Chief of Wollongbar, 130
Venus 8th of Raleigh	A.I.S.	..	3-2-28	24-9-31	273	20	9,795	3·64	357·11	D. Bevan	Royal Standard of Darbalara
Gold 11th of Raleigh	do	..	17-10-27	15-5-31	273	30	9,240	3 85	355·75	do.	Standard of Darbalara
Glanavon Famous Star	do	.	30-8-27	12-6-31	273	15	8,220	4 01	329 98	do.	Premier of Blackheath
Denmark Pamela	Guernsey	1791	6-10-27	25-5-31	273	12½	5,332	5 90	314 81	Denmark State Farm	Rose Chief of Wollongbar, 130
Tulip 2nd of Brush Grove	A.I.S.	18109	3-7-27	18-1-31	273	17	8,871	3 49	310·04	E. C. Melville	Ardee of the Hill. 3002
Spring Park Fox Queen	Jersey	25066	2-8-27	27-3-31	273	15	4 890	6 03	296 52	S. P. Herbert	Prince Marinora of Grassvale, 4582
Nooka Pearl	do	28189	2-12-27	11-9-31	273	12	5 286	5 5	290 04	S. P. Herbert	Jessie's King of Sarnia, 4578
Grassvale Golden Rye 2nd	do.	24947	21-10-27	19-7-31	273	12	5,141	5 53	290 02	R. H. Rose	Mokine Christopher Columbus 1999
Denmark Rose Marie	Guernsey	1796	10-10-27	11-5-31	273	4½	3,658	5 73	209 53	Denmark State Farm	Wollongbar Reformer, 538
Glanavon Pretty Pearl	A.I.S.		2-9-27	24-8-31	210	10	4,170	4 5	181 08	D. Bevan	Premier of Blackheath

COWS OVER 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LBS. BUTTER FAT.

Toora Victress	do.		7-3-28	12-8-31	273	14	7 642	4 65	448 19	W. G. Burges	Victor of Darbalara, 2384
Nooka Carnation	Jersey	25218	17-5-28	28-7-31	273	20½	7 536	5 41	407 74	S. P. Herbert	Jessie's King of Sarnia, 4578
Greenmount Bonnie Lass	do	28237	23-3-28	15-5-31	273	20	6,750	6 30	407 61	A. J. B. Strempel	Werribee Starbright's King, 2602
Empress 4th of the Hill	A.I.S.		26-5-28	10-9-31	273	28	8,709	4 20	365 35	W. G. Burges	Crescent of the Hill, 2016
Spangle 8th of the Hill	do.	.	17-4-28	22-9-31	273	23	7,599	4 68	355 42	do.	Crescent of the Hill, 2016
Moorlands Cora	Jersey	28221	13-2-28	19-5-31	240	10	6,690	5 3	354 66	P. Rose	Grafter of Melrose, 3560
Moorlands Chloe	do.	28214	2-5-28	20-6-31	240	15	6,120	5 67	340 62	do.	Colonel of Melrose, 4015
Muresk Rose	Guernsey	2156	9-5-28	7-6-31	273	13	5,994	5 62	337·09	Muresk Agricultural College	Triumph of Wollongbar, 513
Juadine Peerless Lily 3rd	Jersey	28183	29-9-28	1-10-31	273	16	5 823	5 76	333·88	Miss Hancock	Larry of Juadine, 513
Telyarup Duchess 1st	A.I.S.		9-12-28	21-6-31	273	21½	8 660	3 91	328 68	A. E. Grant	Baron of Darbalara
Moorlands Cherry	Jersey	28213	20-5-28	22-5-31	273	13	6 279	5 08	319 26	P. Rose	Colonel of Melrose, 4015
Nooka Bright Queen	do	28186	29-11-27	28-3-31	273	19	5 982	5 10	307 60	S. P. Herbert	Jessie's King of Sarnia, 4578
Lady Jean 4th of Jerarta Park	A.I.S.	13102	30-10-27	20-11-30	273	20	7 815	3 83	299 72	E. C. Melville	Tulips Hero of Hill View
Folly of Aorangi	do	..	18-6-27	23-10-30	273	5	7,770	3 79	294 73	do	General Maud of Aorangi, 1014
Mokine Columbine 5th	Jersey	24943	20-8-27	17-1-31	273	10	5 040	5 84	292 51	T. H. Wilding	Mokine the Hood, 4925
East View Pendant	A.I.S.	18339	18-6-28	18-6-31	273	13	7 809	3 68	286 70	A. E. Grant	Sultan of East View
Claremont Hilda 3rd	do		21-1-28	13-3-31	273	18	6 864	4 1	281 71	Claremont Hospital for Insane	Searchlight of Sunnyvale
Claremont Laura 2nd	do.		6-12-27	26-4-31	273	12½	6 472	4 35	281 53	do	Telyarup Prince of Claremont
Muresk Violet	Guernsey	2157	26-6-28	9-9-31	273	16	5 298	5 28	279 76	Muresk Agricultural College	Wollongbar Triumph, 513
Wooroloo Gem 3rd	A.I.S.		25-12-28	9-7-31	273	15	6,345	4 4	278 99	Wooroloo State Farm	Triumph of Pine Creek, 2515
Capel Carnation	Jersey	24904	15-9-27	20-11-30	273	13	5 814	4 79	277 79	B. W. Prowse	Montrose East of Glen Iris, 4140
Moorlands Coral	do	28222	15-8-28	15-8-31	273	12½	5 227	5 23	273 56	P. Rose	Grafter of Melrose, 3560
Moorlands Celia	do	28210	17-5-28	26-6-31	240	11	5 520	4 80	264 03	do	Colonel of Melrose, 4015
Colmyn's Topaz Girl	do	24898	9-7-27	3-11-30	240	14	4 710	5 54	260 85	C. H. Ironmonger	Milord of Roelands, 5611
Valeric of Aorangi	A.I.S.		14-7-27	12-10-30	240	10¾	6 167	4 26	261 06	E. C. Melville	General Maud of Aorangi, 1014
Koojan Gem	Guernsey	1982	15-4-27	2-10-30	273	7½	4,822	5 17	249 28	A. W. Wilson	Koojan Golden Governor, 595
Denmark Rose Lady	do	1795	22-8-27	22-12-30	273	17	4 911	5 05	248 06	Denmark State Farm	Rose Chief of Wollongbar 130
Clarendon Eyre Betty	Jersey		28-4-28	27-5-31	210	25½	5 385	4 4	238 24	Sabina Vale Stud Farm	Clarendon Eyre Eminent Achievement

HERD TESTING—*continued*

Name of Cow.	Breed.	Herd Book No	Date of Birth.	Date of Calving.	No. of days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test	Butter Fat.	Owner	Sire.
COWS OVER 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LBS BUTTER FAT—*continued*.											
						lb.	lb.	%	lb		
Tipperary Matilda ...	A.I.S. ..	17901	2–4–28	16–8–31	240	9½	5,715	4·12	235·05	A. E. Grant	Villiers of Darbalara
Viola 2nd of Wangara .	do. ..	17888	23–8–27	4–12–30	273	10	4.650	4·05	190·17	do. ..	Limelight of Darbalara, 1105
Claremont Biddy 9th .. .	do. .	..	28–8–28	14–10–31	180	16	4.650	3·77	172·97	Claremont Hospital for Insane	Clinker of Claremont, 2465
Madame 1st of Tipperary ...	do. ...	..	16–9–27	26–11–30	273	11	4,548	3·65	171·05	A. E. Grant . ..	Villiers of Darbalara
COWS OVER 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LBS BUTTER FAT.											
Nooka Wild Rose . ..	Jersey	28191	31–12–28	7–9–31	273	21½	6,619	5·43	358·55	S. P. Herbert ..	Montrose East of Glen Iris, 4140
Moorlands Clytie	do. ...	28218	1–9–28	20–8–31	273	22½	7,507	4·74	355·72	P. Rose	Grafter of Melrose, 3568
Gem 2nd of Wooroloo	A.I.S. ...	2518	30–11–27	5–10–30	273	20	7,830	4·37	342·24	Wooroloo State Farm	Commercial of Blackheath, 2001
Lofty 2nd of Karawarra ..	do. ..	15950	5–2–29	–9–31	273	21	7,833	4·11	321·67	W. G. Burgess ...	Sailor of Karawarra
Moorlands Crystal ..	Jersey ..	28225	31–7–28	14–7–31	273	12½	6,352	5·00	316·54	P. Rose	Grafter of Melrose, 3568
Telyarup Thelma 2nd	A.I.S. ..	2506	22–11–28	1–7–31	273	10½	7,276	4·34	315·35	A. E. Grant	Baron of Darbalara
Moorlands Camilla	Jersey ...	28207	4–7–28	12–6–31	273	12½	6,532	4·90	313·55	P. Rose .. .	Colonel of Melrose, 4015
Alice of Wooroloo	A.I.S. ...		19–4–28	18–11–30	273	22	7,281	4·16	303·24	Wooroloo State Farm	Triumph of Pine Creek, 2515
Juadine Sparkle 3rd	Jersey ..	28185	15–9–28	5–8–31	273	17	5,676	5·14	289·42	Miss Hancock .	Twylish Fox of the Valley
Moorlands Clara	do. ...	28215	18–8–28	10–7–31	273	12	5,796	4·99	286·12	P. Rose	Grafter of Melrose, 3568
Muresk Primrose	Guernsey ..	2527	3–3–29	12–9–31	273	17	5,331	5·36	284·30	Muresk Agricultural College	Triumph of Wollongbar
Pansy 3rd of Claremont ...	A.I.S. ...	2413	18–9–28	30–6–31	273	22½	7,752	3·59	281·56	Claremont Hospital for Insane	Clinker of Claremont
Tipperary Virginia 1st	do. ...	17903	17–7–28	15–2–31	273	20	6,495	4·3	279·00	A. E. Grant	Villiers of Darbalara, 2386
Wooroloo Gem 3rd	do. ...	2519	25–12–28	9–7–31	273	15	6,345	4·4	278·99	Wooroloo State Farm	Triumph of Pine Creek
Telyarup Milkmaid 2nd ...	do. ...	2505	15–10–28	14–6–31	240	12	7.440	3·72	277·17	A. E. Grant	Baron of Darbalara
Tipperary Pansy ..	do. ..	2442	2–12–28	10–8–31	273	16	6,273	4·18	272·24	do.	Villiers of Darbalara
Delia 1st of Telyarup	do. ...	..	11–11–28	21–8–31	273	6	6,348	4·02	255·00	do.	Baron of Darbalara
Mokine Heroine 5th	Jersey ...	34358	25–9–28	16–9–31	273	11	5,328	4·72	250·08	T. H. Wilding ..	Twylish Fox of the Valley
Denmark Irish Rose	Guernsey .	2154	11–10–28	1–9–31	273	10	4,170	5·77	231·09	Denmark State Farm	Rose Chief of Wollongbar, 130
Tipperary Camellia	A.I.S.	2371	5–8–28	12–3–31	180	23	4.980	3·99	197·28	W. G. Burgess ...	Searchlight of Darbalara
Liberton Patricia	do. ...	2441	1–1–29	5–9–31	240	7½	5,340	3·62	193·20	A. E. Grant	Limit of East View
Springpark Violet	Jersey ..	24903	21–3–28	6–12–30	240	9	2,940	6·20	181·92	W. Padbury .. .	Prince Marinora of Grass Vale
Burnside Queen	Guernsey ...	2542	8–4–29	8–10–31	120	19½	2,925	4·7	140·73	Giblett & Johnston	Minamurra Prairie Don, 743
COWS UNDER 2½ YEARS—STANDARD 230 LBS. BUTTER FAT											
Wooroloo Rose 2nd	A.I.S. ..	2523	27–4–29	23–9–31	273	22½	7,882	4·55	359·02	Wooroloo State Farm	Triumph of Pine Creek
Bella 3rd of the Hill	do. ...	...	13–5–28	30–10–30	273	31	7,893	4·12	325·70	W. G. Burgess ..	Crescent of the Hill, 2216
Moorlands Daphne	Jersey ..	31222	13–3–29	13–6–31	273	11½	5,615	5·62	315·25	P. Rose	Melrose Raleigh, 5860
Tipperary Melba 2nd	A.I.S. ...	2375	23–12–28	27–5–31	273	20	7,185	4·48	314·09	W. G. Burgess ...	Villiers of Darbalara
Burnside Judy	Guernsey ...	2540	5–5–29	19–7–31	273	14½	5,585	5·60	312·57	Giblett & Johnston ...	Minnamurra Prairie Don, 743

Denmark Rosa 3rd	do. ...	2523	5-4-29	14-6-31	273	10½	5,986	5·05	302·32	Denmark State Farm	Wollongbar Reformer, 538
Grangelea Daphne 2nd ...	Jersey ..	33036	4-8-29	13-8-31	273	19	5,857	5 14	301 36	Sabina Vale Stud Farm	Grangelea Dandy
Koojan Polly	Guernsey ...	2665	13-12-28	16-10-30	273	17	5,736	5 13	294 50	A W Padbury ..	Koojan Golden Governor, 595
Moorland's Duchess	Jersey .	31239	11-7-29	8-7-31	273	10	5,790	5 03	291 82	P. Rose	Moorlands Romeo
Banyule Silvermine 59th ..	do. ...	29033	10-2-29	10-3-31	273	18	5 979	4 8	288·79	Sabina Vale Stud Farm	Banyule Superstrain. 4529
Moorlands Doris ..	do. .	31235	14-5-29	19-7-31	273	11½	6,094	4·52	275 83	P. Rose	Moorlands Romeo
Greenmount Gipsy Lass ..	do.	28239	6-3-29	5-5-31	273	13	4,314	6·45	272·39	A. J. B Strempel ...	Werribee Starbright's King, 2602
Greenmount Gipsy Maid ..	do. .	28240	8-3-29	20-4-31	273	15	4,785	5 66	271·00	do. ...	Werribee Starbright's King, 2602
Snowdrop 22nd of Kurrawang ..	A.I.S. ..	18229	14-9-28	7-1-31	273	24	6,732	4·1	270·75	W. G. Burgess ..	Merry Count of Berry, 2692
Mokine Miss Fox	Jersey ..	...	24-11-29	22-9-31	273	17	5,286	4 90	259 90	T H Wilding .	Twylish Fox of the Valley
Moorelands Doreen ...	do .	31234	21-5-29	25-6-31	273	10	5,145	5 02	258·05	P. Rose .	Moorlands Raleigh
Daisy 2nd of Juadine . ..	do ..	34342	24-6-29	20-5-31	273	14½	5,338	4·83	258 00	Miss Hancock ..	Twylish Fox of the Valley
Juadine Juliet 6th ..	do. ..	34344	20-10-29	20-9-31	273	13	4 224	5 99	251 51	do.	Mokine Repulse
Koojan Bonnie Buttercup ...	Guernsey ..	2230	18 10 28	26-2-31	273	12½	4,732	5 38	251 30	A W. Padbury .	Koojan Golden Governor, 595
Claremont Star 2nd	A.I.S. ...	2423	1-8-29	7-9-31	273	16	5,929	4 16	249·71	Claremont Hospital for Insane	Claremont Elector
Tipperary Virginia 4th ..	do	2379	18-8-29	25 9-31	273	20	5,820	4 29	249 24	W. G. Burgess .	Melba's Re-Echo of Tipperary
Greenmount Buttercup ...	Jersey	28238	26-5 29	9-6-31	273	14	4,512	5 52	249 12	A. J. B Strempel .	Werribee Starbright King, 2602
Mokine Empire Twylish .	do. .		30-12-29	27-9-31	273	18	5 086	4 88	245 87	T H Wilding	Twylish Fox of the Valley
Grassvale Golden Cream 3rd .	do		22-8 29	2 10 31	273	11½	4 219	5 46	229·62	R H Rose	Choice Goods of Garden Hill
Lottie 5th of Kurrawong .	A.I.S.	18225	8-10-28	12-12-30	273	20	5,880	3 89	228 99	W G. Burgess	Premier 2nd of Kurrawong
Moorlands Dazzle ..	Jersey	31225	14-9-29	10-7-31	240	10½	4,186	5 34	224 43	P Rose .	Moorland's Raleigh
Greenmount Snowflake ..	do	28242	30-3-29	3-5-31	273	12	4 011	5 52	221 19	A J B. Strempel	Werribee Starbright King 2602
Flash of East View	A I S	18331	4-10-28	22 10-30	273	20¼	5 880	3 75	220 55	A. E Grant .	Mariner of Greyleigh
Muresk Tulip ...	Guernsey	2529	26 6 29	20 9 31	273	13½	4 360	4 95	215 99	Muresk Agricultural College	Minnamurra Gunn, 828
Belle 8th of Claremont .	A I S.	2387	24-8-28	19 11 30	273	16	5,658	3 74	211 78	Claremont Hospital for Insane	Clinker of Claremont, 2456
Devonia Gladies . .	Jersey	31185	1 9-29	4 2 31	273	10	3,855	5 2	210 30	W Hull .	Grassvale Fairy's Duke 2nd
Capel's Prettiest Thing	do	28205	14-11 28	16-11 30	273	8	4 539	4 41	200 35	B. W. Prowse	Bracken Fern of Roelands. 4014
Claremont Whitby Maid 7th	A I S	2425	26 8-28	30 11 30	273	17	4,881	4 09	199·46	Claremont Hospital for Insane	Clinker of Claremont. 2456
Claremont Biddy 10th ..	do	2390	11-10-28	9-11-30	273	11	4 563	4 18	190 84	do ..	Duncan of Claremont, 2467
Claremont Belle 6th . ..	do	2386	29-9 28	23 12-30	273	15	4,365	4 34	189 33	do .	Clinker of Claremont, 2456
Capel Daisy 2nd . ..	Jersey	34349	22-12-29	16-9 31	273	12½	3,562	5 1	183 23	B. W Prowse ..	Bracken Fern of Roelands. 4014
Capel Jean	do	34351	5-1-30	26 10-31	273	12½	4 012	4 57	183 06	do	Bracken Fern of Roelands. 4014
Capel Centenary Girl	do .	.	15-10-29	4-8-31	273	9	3 792	4 90	182 98	do	Bracken Fern of Roelands
Nooka Madiera	do	28188	20-10-28	5-2-31	273	8½	3 131	5 8	181 84	S P Herbert	Jessie's King of Sarnia, 4578
Lonswood Lady Grey 9th ..	do	31212	14-9-29	6-8-31	273	8	3 414	5 34	181 53	S W. Prowse .	Hamel Lea Fancy's Dapper
Tipperary Snowflake 2nd .	A.I.S	2443	1-2-29	11 6 31	240	4	3 930	4 43	174 03	A E. Grant	Villiers of Darbalara, 2386
Lonswood, Lady Fowler	Jersey		1 11 28	28 3 31	240	15½	3 135	5 20	164 38	W Hull	Coolup Democrat, 4917
Snowdrop 25th of Kurrawong	A I S	1378	6-3-29	26-4-31	150	25	3 750	3 80	143 58	W G Burgess	Premier 2nd of Kurrawong
Claremont Lupin 5th .	do	2407	11 10 28	16-1 31	210	16½	3 555	3 80	136 38	D Bevan	Duncan of Claremont, 2467
Claremont Blanche 7th	do	2393	21 3-29	27-5-31	273	9½	4,384	3 07	135 47	Bayley Bros	Elwood of Claremont
Colmyn's Fairy Rye 2nd	Jersey	28192	10 11-28	28-11-30	210	10	2 685	4 84	130 14	C H Ironmonger	Rye Duke of Glen Iris 1994
Claremont Polly 2nd	A I.S.	2419	19-1-29	5-6-31	240	5½	3,225	3 72	112 62	Bayley Bros	Clinker of Claremont
Colmyn's Rye Cream	Jersey	28193	16-11-28	7 2-31	150	6½	1 530	5 4	82 48	C H Ironmonger	Rye Duke of Glen Iris, 1994
Minnamurra Palm Olive	Guernsey	2616	30-8-29	1 1-32	30	20	600	4 48	26 88	Muresk Agricultural College	Caramana Favour
Claremont Cherry 3rd	A I S	2395	2 2-29	15 7 31	30	20½	615	3 50	20 85	Claremont Hospital for Insane	Clinker of Claremont

THE MINERALOGY OF THE DANDARAGAN DISTRICT AND ITS BEARING ON PASTURES AND STOCK.

By

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Government Mineralogist and Analyst.

The Dandaragan District embraces an area about thirty miles long in a north and south direction, and ten miles wide, lying between Moora and the west coast.

In geological structure and topographical features it is a northward continuation of the Gingin area, and closely resembles parts of the south and east of England, the surface consisting of rolling downs carved out of almost horizontal beds of chalk, glauconitic sands, and glauconitic clay shales, the outcrops of which are for the most part heavily covered with soil. The highest ridges reach an elevation of about 1,200 feet * above sea-level.

The geology of the district has been dealt with in a number of short descriptions, a list of which is attached.

Dandaragan is a grazing district chiefly noted for the excellence of the stud and fat stock reared there, including horses, oxen and sheep. These find abundant pasture on the cleared land and open forest, a pasture consisting of native herbage largely augmented by introduced grasses, clovers and other succulent vegetation. This introduction of useful fodder plants is still proceeding vigorously, extensive planting of lupins, subterranean clover, rye grasses, veldt grass, etc., as well as hay crops, being noticeable. Such heavy mixed pastures should enable the stock to secure a well-balanced ration over the greater part of the year. The only fault observed in them is an excessive growth of Cape dandelion in places in the winter, with a tendency to smother more valuable herbage. In late summer the pastures dry up considerably and need supplementing, especially with protein-bearing and lime-bearing feeds.

The district is well supplied with water. The average rainfall over 34 years for Dandaragan townsite has been 27.18 inches. This is spread over the year as follows:—

January-March.		April-June.		July-September.		October-December.
1·33	...	10·37	...	12·60	...	2 88

At the Yatheroo (south) end the rainfall is slightly heavier; at the Mungedar (north) end slightly lighter. The top soil is mostly fairly porous, so that the vegetation on the spot gets the full advantage of any rain, while streams are comparatively small and far between. The run-off is, however, sufficient to ensure that the numerous dams fill easily, whilst supplementary supplies of water are obtained from shallow wells and numerous soaks or springs. These, so far as sampled, are all of low salinity.

Stock diseases are of slight incidence. A little "Gingin rickets" in sheep, and some slight deterioration in the quality of wool, however, have been experienced at the south end. As will be apparent later, it is extremely unlikely that this is due to any deficiency unless it be of salt, or to a lack of balance in the feed, unless possibly an excessive ratio of phosphorus to lime, or, in certain places and seasons, a deficiency of leguminous herbage. At latest it appears rather to be due to some vegetable poison.

* Cowalla Bluff is 1,195 ft.

The soils of the district vary greatly in mechanical condition, from a pure coarse sand of white or yellow colour on some of the uplands, through rich sandy loams, and clay loams, to occasional areas of stiff clays and typical black "rendzina," a fertile type of soil characteristic of chalk outcrops the world over.

These soils are a result of the weathering of the underlying rock masses, and owe their present condition firstly to the mineral constituents of the underlying rocks and those which have been eroded away from above and around them, and secondly to the effect of rain, air, and micro-organisms upon those minerals, and upon the surface accumulation of rotting vegetation.

The chief rock masses disclosed are:

(1) Soft sandstones and unconsolidated sand beds.
(2) Glauconitic sands, the weathered outcrops of which are often hard ironstones.
(3) Glauconitic clay shales.
(4) Non-glauconitic clay shales.
(5) Chalk.
(6) Phosphatic pebble beds.
(7) Recent alluvium composed of the mixed remnants of all of the preceding.
(8) Spongolite (sponge spicule rock) of limited extent, but used as building material in the town of Dandaragan, where it occurs under the soil of meadow land.

The chief mineral components of the rocks and the overlying and resulting soils are described below:—

(1) *Quartz.*—This mineral, which composes almost the whole of the sandy portion of the local rocks and soils, is of no value as a source of nutriment to plants or stock. It is, however, a necessary matrix for such nutrients, and exerts a profound influence upon the texture of the soils, keeping them friable as well as open and permeable by air and moisture.

(2) *Kaolin* (hydrous silicate of alumina). A major constituent of the clay shales and more clayey soils, and present to some extent in all soils. Of no nutrient value but of great mechanical value in rendering the soils more compact and retentive of moisture. Mixtures of quartz and kaolin in due proportions form the mechanical bases of the most fertile of all soils in temperate regions.

(3) *Halloysite* (hydrous silicate of alumina).—A mineral closely related to kaolin, but more sticky and binding, and more retentive of moisture. It also assists in retaining metallic bases of nutritive value.

(4) *Limonite* (brown iron hydroxide).—A constituent in greater or less amount of all soils, particularly of those with a red or brown colour. Also abundant in ferruginous sandstones and ironstones. It is a most important element in the mineral complex of any area, as forming the chief source of the iron so essential for both stock and plant life. Small quantities of manganese are invariably associated with it, and these, too, are essential to living organisms, being necessary to stock if anaemia is to be avoided.

In the Dandaragan district limonite appears to be derived largely from the weathering of glauconite (see below), and many of the outcrops of glauconitic sand beds are represented by dense ferruginous sandstones or ironstones, whilst ferruginous clays result from the decomposition of glauconitic shales.

In the table of analyses attached hereto it will be seen that iron oxide (Fe_2O_3) is abundant in all the material collected throughout the district. Ironstone from Jurien paddock and the home paddock of Mungedar estate (D1 and D6) carried respectively 61 and 40 per cent. of iron oxide with appreciable traces of manganese. Four ferruginous sandstones from Jurien paddock, Mungedar (D2, 3, 12 and 13), carried 24 to 56 per cent. iron oxide. Five soils from Mungedar and Yatheroo carried 3 to 10 per cent., and others in the district, which were not sampled, plainly carried much more. The phosphatic pebble beds are highly ferruginous in places, and even the whitest of those collected, viz., that from Bowers Block 284, near Minyulo, had nearly 4 per cent. iron oxide.

Dandaragan Phosphate Deposits.
Typical Pasture Land in Chalk and Greensand Country, Block 284, South Dandaragan. Phosphate Bed runs past Vehicle to Hole in right Foreground.

No bog iron ore was observed, such as might be utilised for the manufacture of commercial stock licks for use in areas less plentfully supplied with iron.

Wherever looked for, whether in soils, rocks, or pebble beds, an appreciable amount of manganese was found to be associated with the iron, quite sufficient to supply all the requirements of pasture and stock, except perhaps on the actual chalk outcrops where the abundant calcium carbonate depresses the availability of the manganese.

(5) *Glauconite* (hydrous silicate of iron magnesium and potassium).—This is usually a rare mineral in soils and rocks, but is characteristic of the chalk formation in several parts of the world, and is very abundant and almost universally distributed in the Dandaragan district. The pure mineral contains 7 per cent. of potash and 32 per cent. of iron oxide, and as it is decomposed fairly readily by the atmosphere and soil waters, it is of the greatest importance as a source of both potash and iron for plants and animals. Glauconite is a mineral which forms in small dark green grains in shallow coastal sea waters, and as most of the underlying rocks in this district appear to have been formed under such condtions it is not surprising to find glauconite distributed through almost all of them, whether sandy, clayey, or chalky, in quantities ranging from 1 or 2 per cent. up to as much as 40 per cent. of the whole rock. During the disintegration of the original beds

it finds its way into the resulting soils, where it can be detected wherever looked for. A rich black alluvial loam from the home paddock at Mungedar was especially rich in glauconite, about 14 per cent. of that mineral being present. The phosphatic beds also carry quite appreciable amounts, as the potash figures in the attached table indicate.

This wide distribution of a rather easily decomposable potash compound is of the greatest importance in maintaining healthy and vigorous pastures. In the south of England, north of France, and eastern States of the U.S.A. glauconitic sands and clays have been used for centuries for fertilising orchard and hop lands as well as pastures.

A modern use for clean glauconite is in the softening of factory and general town supplies of hard water. Inquiries have been received from both the Eastern States and England for commercial supplies, and it is probable that they may be found of suitable quality in the Dandaragan district.

(6) *Calcite* (carbonate of lime).—This mineral forms the chief constituent of the chalk deposits of the district. There is some uncertainty as to whether the numerous outcrops met with from about two miles south of Gingin to Wathingarra (Emu) Hill, a distance of 65 miles, are all portions of one bed or whether there are several such beds. That the chalk is of the same geological age at Gingin and Kayanaba has been proved palaeontologically by L. Glauert, and the writer is inclined to think it is all one bed dipping slightly southwards, and that the erosion of the valleys has left it exposed round the contours of the ridges. W. D Campbell estimated that the bed is 40 feet thick at Emu Hill, but boring done there at my suggestion shows that it is only about 18 feet thick, which appears to be an average throughout the district.

The outcrops, being usually on gentle slopes, cover often a width of many chains and yield a very rich "rendzina" soil, a typical example of which has been analysed with the results shown in the table, viz., No. 4 from Emu Hill. Further, the benefit of this abundant supply of lime is felt in the soils below the chalk horizon, whilst for those above it which may show a deficiency of lime, it provides a source of artificial supply. Incidentally, it assists in the liberation of potash from glauconite.

One was hopeful that some portion of the chalk bed might be sufficiently free from silica to constitute a good material for cement making. At the two points sampled, however, it was found to be too highly siliceous for that purpose. (*Vide* analyses of D 10 and D 11 in the table.)

The chalk is also of importance as a guide to an horizon characterised by the presence of a pronounced bed of phosphatic pebbles which occurs at its base.

(7) and (8) *Apatite* (fluophosphate of lime) and *Dufrenite* (basic phosphate of iron).—In many parts of the district phosphatic nodules, composed largely of apatite, are found at the base of the chalk bed. Sometimes they are seen as isolated pebbles in the soil, or else *in situ* in the chalk or in the uppermost layers of the underlying glauconitic clay or sandstone. At other times they form dense masses of pebbles and boulders from one to six feet thick, cemented together with sand, clay, limonite and, in places, dufrenite. It was the last-named bright green mineral which attracted the attention of the first discoverer of these phosphate beds nearly 50 years ago, viz., Mr. John Cook, who still lives in the district and pointed out to me the site of his first discovery near Cowalla Bluff. The first analyses of them were made by the writer in 1906, and a much more detailed examination was made in the following year of a series of samples collected by W. D. Campbell, Geological Surveyor.

No reliable estimate of the average thickness of these important beds could be made on the present occasion, as the few small holes sunk in them many years

ago have fallen in, and the low outcrops on gently sloping ground do not lend themselves to exact measurement. At comparatively small expense, however, this thickness could be ascertained at two or three typical places.

W. D. Campbell's map and report suggest that he considered the phosphate beds to be confined to a narrow north and south strip of country associated with the main escarpment of the Darling Range, and possibly congregated at a few isolated points along that line. The writer's own impression is that they are continuously, though not necessarily uniformly, associated over the whole district with the base of the chalk bed, passing under the ridges in an almost horizontal plane and coming quite or almost to the surface along a contour which follows not only the face of the range but also the sinuous contours of the sides of the valleys running in from it. The outcrop is concealed over considerable stretches by the soil, but it is certain as the result of my visit that there are many more places than those mapped by Campbell where phosphatic pebble beds can be seen, or loose pebbles collected from the soil. Their influence in raising the phosphorus content of the soils and rocks to an unusually high figure over very wide areas is shown wherever these have been tested.

In detail the phosphatic pebbles are rounded and range from half an inch up to 3 or 4 inches in diameter. They are composed very largely of granular apatite, contaminated to a minor extent with grains of sand, glauconite and calcite. Apatite is a phosphatic mineral readily dissolved by weak mineral acids, and quite appreciably attacked by carbonic acid, properties which make it a valuable natural fertiliser. Mostly the pebbles are soft and porous, and of a cream colour, but not infrequently they are dark grey and much harder and denser. On Bowers Block 284, in the Koodiwoodi Ridge, associated with many pebbles of the usual type, are some much larger "stink stones." These are hard dense boulders composed of about equal parts of coarse quartz sand, and compact grey apatite, which when split give off a strong odour of hydrogen phosphide and hydrogen sulphide. Individual specimens of them yielded 15.4 and 13.7 per cent. of phosphoric oxide (Nos. 26 and 29 in the table). Other more normal nodules from various places showed phosphoric oxide 25.3 per cent. (D 22, Emu Hill); 26.3 per cent. (W.D.C. 6979, Block 1102, Cowalla); and 19.2 per cent. (L.G. 2344, Kayanaba). H. Rowley's four picked samples secured in the vicinity of Cowalla and Minyulo assayed 30.60 to 37.74 per cent. P_2O_5 with 35 to 51 per cent. of lime and 1.7 to 9.6 per cent. of iron oxide. Similar nodules from Gingin have yielded from 22 to 25 per cent. of P_2O_5 with 2.9 per cent of fluorine and 40.6 per cent. of lime, proving beyond doubt that apatite is their principal constituent.

In nearly every outcrop of the pebble beds the writer observed angular blocks of fossil wood now composed of the same mineral as the pebbles themselves, viz., apatite Their composition has been proved by analysis (W.D.C. 6979 in the table), and their high phosphorous content (39 per cent. P_2O_5) and very porous texture give them valuable fertilising properties.

Very unevenly distributed through the pebble beds is the green iron phosphate *Dufrenite*. It has been formed by interaction between the apatite nodules and the weathering glauconite. This mineral is unfortunately insoluble in dilute mineral acid and it is improbable therefore that it should have any appreciable fertilising power in its natural state. It can, however, by chemical processes be converted into a more readily soluble form.

In the accompanying table a distinction has been drawn in most cases between the phosphoric oxide soluble in dilute acid, which is that present as apatite and slowly available as plant food, and that insoluble in dilute acid, which is present as dufrenite, and is not available as plant food.

Whilst picked nodules and fragments of fossil wood carry up to 39 per cent. of phosphoric oxide, it would be impossible to hand-pick or otherwise concentrate

those in the outcrops on a large commercial scale. If the beds are to be utilised commercially it is average values of the beds as a whole that must be considered. The figures available for different outcrops that have been examined are as follow:—

Place.	P_2O_5 soluble ‡	P_2O_5 insoluble.‡	P_2O_5 total.	K_2O.
	%	%	%	%
Loc. 957, Cowalla	12·8	2·5	15·3	1·9
Block 1102, Cowalla	10·5	4·7	15·2	2·0
C.G. 1110 East side } Minyulo	8·5	4·4	12·9	2·0
C.G. 1110 West side } Minyulo	6·7	5·6	12·3	?
Loc. 284, Koodiwoodi	13·2	1·0	14·2	?

‡ In dilute (2½E) nitric acid.

Between 1907 and 1909 H. Rowley, a consulting chemist in Perth, spent a great part of his time in experimenting with methods for converting the phosphates of these beds into a water soluble form with a view to using them elsewhere in the State as a fertiliser. His richest average rock only assayed 17.9 per cent. P_2O_5, and he did not apparently appreciate the fact that the first problem to be solved was the concentration of average rock assaying only 12.3 to 17.9 per cent. P_2O_5 to at least double that grade. Rock of such low grade would never pay to treat chemically in its original state, and even if the whole of its P_2O_5 was made water soluble the resulting fertiliser would be of too low grade to handle economically.

He took out four patents for chemical treatment of the rock, and applied for a fifth, but did not finalise it. His earlier patents involved a double melting of the rock with other salts and minerals, chiefly compounds of sodium and magnesium, and would have cost at least twice as much as the final fertiliser was worth. His last accepted patent, No. 15613, was for treatment of the very finely pulverised rock with a slight excess of strong caustic soda solution with or without heat. This process was subjected to extensive tests by Rowley himself, as well as by Dr. F. S. Earp and Mr. W. Moller, a European fertiliser chemist. The last named condemned the process on the grounds of high cost, as well as the low grade, variable solubility and alkalinity * of the finished product. Since Rowley's time no further effort has been made to commercialise the deposits.

It would seem as if the beds are of such low grade as to be valueless at present except for local use, unless further exploration should reveal richer concentrations of phosphatic material, or unless the beds, when followed under cover from the outcrops, exhibit harder pebbles in a softer matrix (as is quite possible), which would be capable of concentration by washing and sifting, as is done with the Florida pebble beds. This is a possibility well worth testing by means of a drive, which would also determine the thickness of the beds.

Meanwhile they have done good service in supplying the whole neighbourhood naturally with an abundant supply of phosphorus in the soil. This supply is many times greater than that which could possibly be added in the form of an artificial fertiliser, being anything from 2 to 10 tons per acre foot.

*** Moller's figures show from 2·6 to 15·6 per cent. "free alkali," presumably calculated as caustic soda (NaOH).**

E. A. Mann in another series of products found 1·2 to 23·4 per cent. NaOH.

Salt.—Many parts of the State are unfortunate in the possession of an excess of salt both in the soil and in the natural waters. Most useful plants are so easily poisoned by salt that no area can be too free from it so far as the healthy growth of pastures and crops is concerned. But districts like Dandaragan which are hilly and provided with a good rainfall are liable to have too little salt for the healthy growth of stock, all of which require a considerable amount to ensure perfect digestion and assimilation of food.

My visit to Dandaragan was made in the midst of the rainy season when it is impossible to get an accurate idea of the salinity of the soil and surface waters. This is best determined in the autumn.

Four samples of water were, however, obtained and analysed. One each from a well and a dam at the north end, and the same from central Dandaragan. The results obtained were:—

—	DAMS.		WELLS.	
	Block 1178, Mungedar.	Block 833, Dandaragan.	Block 520, Mungedar.	Res. 18113, Dandaragan.
	Grains per gallon.	Grains per gallon.	Grains per gallon.	Grains per gallon.
Total soluble salts ...	7·00	28·0	11·20	21·0
Salt (NaCl)	3·71	19·2	5·53	5·7
Reaction	Faintly acid	Faintly acid	Faintly acid	Faintly acid
pH	6·3	6·0	6·4	6·0

All these waters are unusually fresh, rather too much so for stock. It is probable that all stock in the district would benefit by the regular provision of a salt lick, which should not, however, contain any phosphate.

Dandaragan Phosphate Deposits.
Outcrop of Phosphatic Pebble Bed on Block 957, near Cowalla Bluff.

Other Elements essential to Pastures and Stock.

Nitrogen.—No time was available to deal with soil nitrogen in detail. Of the two soils collected at Emu Hill and Mungedar homestead, the former was unusually rich in nitrogen, the latter of normal content. There was no visible evidence of

any lack of nitrogen in the pastures anywhere, and it was obvious that most of the soils contained abundant nitrogen-bearing humus, which was being constantly renewed by stock droppings, decaying herbage, and fixation of nitrogen by leguminous herbs.

Manganese and Copper.—Both of these are essential to vigorous plant growth and to the avoidance of anaemia in animals. As already stated above, a sufficiency of manganese was found to accompany the iron at Dandaragan almost everywhere it was looked for (see table below). No deficiency in that element is likely to occur except over the actual chalk outcrops.

Copper was determined in four specimens of phosphate rock, and found to range from 32 to 60 parts per million of rock, which is sufficient for all crop and stock requirements in the vicinity of these rocks. No figures are available as to its distribution in other rocks and soils.

Magnesium is only required in small quantities and is abundantly present in chalk, glauconite and clay beds, as well as in the natural waters of the district.

Iodine.—No survey of the distribution of this element, recently shown to be of great importance to living organisms, was possible in the time available. It is on record, however, that lime phosphate rocks from other parts of the world are comparatively rich in iodine, averaging 6 parts of that element per million. There is reason to believe that clovers and related plants are unusually rich in iodine, and wherever such plants are abundant and luxuriant no deficiency of iodine is likely to appear in stock.

Fluorine, an essential constituent of bones and teeth, is present in immense quantities in the phosphate beds, where it is a constituent of the easily decomposable mineral apatite.

Summary.

The Dandaragan district is an unusually fertile area provided with a good rainfall, and singularly free from any mineral deficiency (except possibly salt) likely to adversely affect either crops or herds. It is one of the very few districts in Australia which is abundantly supplied by nature with phosphates, not only evenly distributed throughout the soils and underlying rocks, but also concentrated in an extensive bed of phosphatic pebbles. No pasture dressing with artificial phosphates, nor provision of phosphatic licks to stock should be necessary.

The soils are also abundantly provided with potash and iron, owing to the wide distribution of glauconite, a somewhat unstable mineral which contains a high percentage of both elements.

Lime tends to be easily leached out of the soil, so that although a bed of chalk extends throughout the area, certain portions of it may require lime dressing from time to time, and for this the local chalk may be looked upon as an ideal material.

The apparent absence of salt is conducive to the development of luxuriant pastures, but salt licks appear to be necessary for the stock.

Commercial exploitation of the phosphate beds does not appear feasible from the outcrops, which are of too low an average in phosphorus, and are in such a physical condition as to preclude economical concentration. By further exploration, particularly into the hills under cover, beds may be found more amenable to treatment. They should be tested at two selected points by means of drives. Meanwhile they are a valuable reserve for local use in any intense culture.

Other commercial minerals worth further investigation are the glauconitic sands and the chalk.

Large areas of the district appear well suited for closer settlement, particularly in the form of small self-contained "mixed" farms, and orchards for the growth of warm climate fruit, such as oranges, passion fruit, grapes, etc.

TABLE I.

ANALYSES OF MATERIAL FROM PHOSPHATE BEDS, DANDARAGAN.

Parts per cent

No	ESS 3	ESS 12	ESS 13	ESS 22	ESS 7.	WDC 6985.	ESS 16.	ESS 20	ESS 28.	ESS 15	WDC 6980.	WDC 6979A.	ESS 21.	WDC 6977.	WDC 6978.	WDC 6979C.	WDC 6979B.
Material	Siliceous Ironstone with Nodules.			Average of Nodules.	Phosphatic Ironstone	Phosphatic Greensand	Ferruginous sandstone with phosphatic nodules and phosphatised wood.			Phosphate Bed with little Dufrenite.			Phosphate Bed with much Dufrenite.			Clean Nodule.	Fossil Wood.
Locality	Jurien Paddock, North of Emu Hill.			Emu Hill	Mungedar Homestead	Mardo Tank.	Loc. 957 Cowalla			Midland Block 1102, Cowalla.							...
P_2O_5 sol. in dil. HNO_3* ...	...	2·14	·38	...			14·30	14·87	9·31	18·92	...	...	6·43	·06	...	...	...
P_2O_5 insol. in dil. HNO_3 ..	...	1·94	·73		...	...	2·2	3·64	1·54	1·12	...	...	5·77	7·19	...	...	...
P_2O_5, total	1·60	4·08	1·11	25·26	1·27	2·10	16·52	18·51	10·85	20·04	15·32	18·26	12·20	7·25	9·63	26·26	38·80
CaO (Lime)	...	...	...	...	...		...	...	...	...	...	15·80	...	0·8	...	...	53·88
Fe_2O_3 (Iron oxide)	35·72	54·80	56·64	...	70·50		15·47	23·42	30·36	12·11	29·31	26·42	27·92	32·14	...	4·17	1·01
Mn_3O_4 (Manganese oxide) ...	Present	·13	·15	...	...	...	·013	·008	·03	·007	...	...	·014	...	...	...	·78
K_2O (Potash) acid sol. ...	...	1·02	...	...	·08	...	...	1·90	...	2·04	...	...	...	...	...	...	trace
Na_2O (Soda) acid sol. ...	...	·03	...	...	14	...	...	·26	...	·20	...	...	...	...	...	...	trace
Siliceous Insol.	21·36	19·03	21·72	...	10·18	...	29·68	18·84	31·44	22·08	27·02	21·27	39·87	47·54	...	28·66	1·26
Ignition Loss	...	...	...								9·60	7·83	...	7·35	...	2·50	1·02
Al_2O_3 (Alumina)	27·05	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	trace
MgO (Magnesia)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·17
CO_2 (Carbonic acid)	...	...	...	...	...		...	...		...	...	...	...	...	...	...	1·31
Fluorine	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3·00
Copper, parts per million ...	...	...	...	...	...	...	...	18		60	...	...	...	...	...	...	...

* P_2O_5 = Phosphoric oxide. HNO_3 = Nitric acid.

TABLE I—*continued.*

ANALYSES OF MATERIAL FROM PHOSPHATE BEDS.

No.	LG 2344.	ESS 24	ESS 25	ESS 14	ESS 19.	ESS 18	ESS 23	ESS 17.	ESS 30.	ESS 26.	ESS 29.	Rowley 1.	Rowley 2
Material	Phosphate Nodule	Ferruginous sandstone with phosphatic nodules		Pebble Bed with much Duricrite		Black phosphatic Ironstone	Sandstone with Nodules.	Phosphate Bed. Irony part	Phosphate Bed. Limey part.	Small Stink-stone.	Large Stink-stone.	Average phosphate Rock.	
Locality	Kayanaba	CG 1110 "Hole in the Wall," Minyulo					West side of CG 1110	Loc 284 Koodlwoodi Ridge.				Cowalla or Minyulo.	
P_2O_5 sol. in dil. HNO_3	..	8·80	5·73	15·84	7·18	5·22	6·74	13·24	6·89	15·43	13·69	...	...
P_2O_5 insol. in dil HNO_3	...	1·32	·92	2·67	6·29	10·92	5·56	·96	*nil*	*nil*	*nil*	...	..
P_2O_5, total	19·16	10·12	6·65	18·51	13·47	16·14	12·30	14·20	6·89	15·41	13·69	17·88	17·14
CaO (Lime)	...	...	.	...	..	...	...	..	..	...	..	...	11·70
Fe_2O_3 (Iron oxide) ..	...	25·85	47·03	26·21	27·82	41·66	31·54	16·89	3·77	.	..	...	20·70
Mn_3O_4 (Manganese ox.	...	·01	·03	·03	·01	·01	·09	·07	·03	..	...	...	...
K_2O. (Potash) acid sol.	...	..	...	3·38	2·33	·50	...		.	..	...	...	...
Na_2O, (Soda) acid sol.	..	...	..	·36	·78	1·14	...	..	..	...	...	...	...
Siliceous Insol ..	...	37·67	26·40	29·67	33·90	19·76	31·77	25·56	23·79	48·10	54·74	28·04	..
Ignition loss	..	...	...	.	...	..	..	..	..	..	..	...	...
Al_2O_3 (Alumina) ...	..	.	..	...	.	.	.	.	.	.	...	..	...
MgO (Magnesia) ...	.	.	..	.	.	.		.	..	..	..	...	...
CO_2 (Carbonic acid) ...	..	..	.		.	.	..	.			.	..	..
Fluorine .. .	.	.		.			..	..	.	.	..	..	..
Copper parts per million	..	.			44			32			..	.	...

TABLE II.

ANALYSES OF ROCKS AND SOILS, DANDARAGAN.

Parts per cent.

No.	ESS 11.	ESS 10.	ESS 31.	JM 1.	ESS 6.	JM 2.	ESS 8.	ESS 4.	AFF 1067.	AFF 1070.	ESS 5.	AFF 1068.	AFF 1071.	AFF 1066.	AFF 1069.
Material	Chalk.		Glauconitic Clay below Chalk.	Sandy Ironstone.		Ferruginous Sandstone.		Rendzina Top soil.		Rendzina Sub soil.	Meadow Loam.	Meadow Top soil.	Meadow Sub soil.	Marri Forest Top soil.	Marri Forest Sub soil.
Locality	Emu Hill.	Kayanaba.	Emu Hill.	Jurien Paddock.	Mungedar H'stead.	Jurien Paddock.	Mungedar Homestead	Emu Hill	Yatheroo.	Yatheroo.	Mungedar Homestead	Yatheroo.			
P_2O_5, total	1·12	·57	2·55	·91	47	·14	·23	·364	·59	·37	·230	·07	·12	·06	·08
CaO (Lime)	34·82	30·29	...	...	...	..	.	16·89	25 04	51 72	·03	·04	·32	·24	·11
Fe_2O_3 (Iron oxide) ...	2·43	4·12	...	61·72	40·44	24·13	8 86	7·55	11·51	4·00	7·07	3·26	1 25	5·00	2·25
Mn_3O_4 (Manganese ox.)	...	...	..	Present	Present	trace	...	·003	..	...	·002	...	...	...	...
K_2O, (Potash) acid sol.	·08	1·08	1·59	...	...	...	...	·466	·70	·35	1·01	·18	·16	·06	·26
Na_2O, (Soda) acid sol.	·29	·26	...	...	...	..	...	...	...	...	...	...	...	...	...
Siliceous insol.... ...	23·53	31·36	...	6·63	41·15	71·11	78·81	...	...	..	...	...	...	...	...
Ignition loss	·66	...	...	...	...	...	...	21·6	...	...	3 6	...	...	...	...
Al_2O_3 (Alumina) ...	3·13	3·83	...	17·00	...	·98	...	...	...	..	...	...	...	...	...
MgO (Magnesia) ...	1·31	·63	...	...	...	..	...	..	2·07	2·12	...	·09	trace	·07	trace
CO_2 (Carbonic acid ...	26·69	...	...	...	..		..	..	..	...	...	..	...	...	...
H_2O (Water)	5·32	2·58	...	...	...	...	..	...	...	...	...	...	...	...	...
Nitrogen	...	...	...	...	...	...	..	·406	...	...	·112	...	...	...	...
Cu, parts per mill'n ...	...	...	...	...	...	...	...	6	...	...	9	...	...	...	...
pH	...	...	...	...	...	...	...	7·71	...	...	5·35	...	...	...	...
Reaction	...	...	...	...	...	...	...	Alk.	...	...	Acid	...	...	...	...

TABLE III.

MECHANICAL ANALYSES OF TWO DANDARAGAN SOILS.

Mark	ESS D4	ESS D5
Nature of Soil	Rendzina	Meadow
Locality	Emu Hill	Mungedar
	per cent.	per cent.
Coarse sand	10·6	37·6
Fine sand	21·0	45·8
Silt	4·4	2·6
Clay	25·7	10·0
Moisture	6·9	2·4
Loss on acid treatment	29·6	0·1
Loss on ignition	21·6	3·6
Calcium carbonate	22·8	*Nil*

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WEB-WORM

(*Sclerobia tritialis*).

By L. J. Newman, Entomologist.

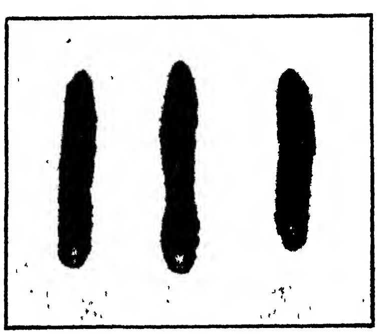
There has been a considerable recrudescence this winter of the Web-worm (*Sclerobia tritialis*). In every instance the outbreaks have been on dirty stubble or grass lands turned in late. This pest is absolutely non-existent on fallowed country.

The parent moth of these Web-worms is a small, inconspicuous species. When at rest the wings are closely folded around the body, the colour of the wings closely harmonising with the dry stems of wheat or grass. From tip to

tip of outspread wings measures about one inch. The egges are tiny, round, pale yellow bodies, and are laid amongst grass and stubble. The parent moths issue after the first autumn rains and are naturally attracted to grass or stubble land. Fallowed land free of weeds or old stubble has no attraction to the moths.

Web-worm Moth (*Sclerobia Tritialis*).
Enlarged. (Orig.)

The eggs are turned in with the ploughing and sowing of the crop. If late ploughing, the eggs may have already hatched. These eggs or young cterpillars are not destroyed by the process of ploughing, and hence they attack the young wheat as soon as it begins to grow. The feeding capacity of these caterpillars in the early stages is not sufficiently great to retard seriously the growth of the crop. Later on, however, if the Web-worms are numerous, they cause very serious loss. The catepillars live within silken tubes, which they spin at the base of the plant attacked. They come out at night and cut off and draw the food into their tunnels and there consume it.



Larvae of Web-worm.
Enlarged. (Orig.)

This caterpillar does not migrate in armies as do the Army-worms, but take a crop of grass or wheat on a face. As they demolish one stool they move on to the next. Unfortunately there is very little second growth once this pest has been over a crop. This is due to the fact that the wheat plants are eaten down

below the crown. Several caterpillars may be found in a single wheat stool. This pest is troublesome to crops only when it outbreaks in a crop.

When fully grown the caterpillars pupate within their silken-lined tubes.

Native Grass cut down and destroyed by the Web-worm (*Sclerobia Tritalis*). Note the entrance holes to the silk-lined tunnels in which the caterpillars reside. (Orig.)

Preventive measures.—First and foremost aim at only cropping on fallow. Do not allow rubbish and weeds to accumulate. If not possible to fallow grass or stubble, lands intended to be sown to crop should be burned over. This will, if it is a good burn, remove much of the old grass and stubble, thus removing the natural attraction to the moths when they issue.

Examine crops at regular intervals and when patchiness is noticed investigate the cause at once. Look under clods, examine the base of the wheat stool, and if caterpillars of any description are found to be damaging the crop, take prompt action.

Remedial measures.—If caterpillars have broken out in patches, plough a sharp trench or ditch around each infested area. A coulter should be used in order that the edge of the furrow may be as sharp as possible. The sharp edge should be opposed to the advancing caterpillars. This trenching is only for the purpose of halting the advance of the Web-worms. **Poison baiting** must then be employed. The following bait has been found very effective:—Bran 30 lbs., Paris green or sodium fluoride 1 lb., molasses or treacle 4 lbs. The bran and the poison may be mixed in a dry form. The molasses is broken down with hot water, until of a thin consistency. This is then stirred into the bran and poison and mixed to a moist crumbling state. The bait is then broadcasted amongst the caterpillars as late in the day as possible. This mixture is very attractive to the caterpillars when they crawl about in search of food. Spread the bait as thinly as pssible, avoiding wet lumps.

If caterpillars still persist, it will be necessary to make a second and perhaps a 1hird application at intervals of three to five days.

Crop that has been so badly attacked as to be worthless, should be fallowed as soon as possible.

DUST IN OUR AGRICULTURAL WOOLS.

HUGH McCALLUM,
Sheep and Wool Inspector.

The damage done to wool by the unnecessary exposure of sheep to dusty conditions can with a little forethought be considerably minimised throughout the Wheat Belt.

Undoubtedly on a wheat and sheep farm, when the fallows are being fed off from time to time, they become more or less dirty with various weeds. Very often little attention is given to sheep at the time they are being shorn to prevent the sheep from raising dust; unnecessary yarding and driving sheep across fallow instead of going around same will raise dust that will penetrate to the skin and remain to form the tip of the staple. The dust absorbs the natural grease which is needed for the healthy and sound growth of the fibre, and spoils the appearance of the wool. The tip of the wool becomes dry and wasty, resulting firstly in a heavy loss in scouring owing to the quantity of dust. This waste can be eliminated to a great extent by allowing the sheep as much spread as possible when mustering or droving. Constant rounding of the sheep by dogs stirs up dust and works it into the staple.

The less dust in wool from our sheep farms, the better price per pound for the clean and bright wool. Every particle of dust which adheres to the fleece reduces its yield and detracts from its appearance. Wool clips that are bright and clean attract the buyer's eye, especially since one of the factors influencing his purchase is the percentage of clean yield. The care of sheep and the prevention of dust gaining admission, when it can be avoided, from shearing to shearing, will greatly assist in obtaining higher prices for the clip.

On many stations and farms it is the practice to water the yards at intervals to keep down the dust. Such a sound and inexpensive method might well be adopted wherever practicable.

OBITUARY.

The Department of Agriculture, as well as the State, has suffered a severe loss in the decease of two prominent citizens in the persons of Mr. C. J. Craig, Chief Inspector of Rabbits and Vermin, and Mr. E. J. Limbourne, Cereal Breeder of the Merredin Experiment Farm.

The late Mr. C. J. Craig was first employed with the Department in 1902 when the Rabbit-Proof Fence was commenced. It was then found that rabbits were beyond the fence line and the services of experienced and qualified men were sought to cope with the invaders, and it was in this capacity that Mr. Craig found employment. Towards the end of 1904 his ability to impart instruction to others, coupled with the success of his own efforts, gained for him official recognition and caused him to be singled out to take charge of the northern section of the No. 1 Rabbit-Proof Fence when it was completed by the

The late Mr. C. J. Craig.

Public Works Department. He remained thus in charge until 1914 when, on account of the increase in rabbits in the settled areas, he was transferred to Head Office as Rabbit Inspector, a position which he retained until 1924, when he was advanced to that of Chief Inspector, occupying this position with signal success until the time of his death. He had a lifelong experience of rabbits and the various animal pests which affect the pastoral and farming community, enabling him to impart necessary advice to all inquirers, and his unfailing courtesy was appreciated by all who met him.

Mr. E. J. Limbourne came to this State in January, 1912, from Birmingham, England, and shortly after the outbreak of the Great War enlisted with the 44th Battalion, seeing active service on the Western Front, where he was badly gassed. Invalided home in 1918 he joined the staff of the Merredin Experiment Farm in November of the following year, where he was associated with the work of cereal improvement, being subsequently appointed to the position of Cereal Breeder. Possessed as he was with a natural ability in this direction, and a capacity for detail coupled with a keen sense of observation, it is not surprising that in the space of 13 years he achieved great success. Amongst the more

The late Mr. E. J. Limbourne.

important of the achievements to which his enthusiasm largely contributed, were the development of the Bencubbin and Totadjin varieties; both flag smut resistant and high in productivity. It is probable that these varieties may yet become the most widely grown in the State and Commonwealth. Noongar, the earliest maturing variety under cultivation, came as a result of his labour, and several cross-breeds which we hope will yet add considerably to the wealth of our agricultural industry. Maintenance and improvement in type and productivity of the standard varieties produced for pedigree seed at the Merredin Farm also claimed his attention, and the value of such seed is now universally recognised by the farming community.

Mr. Limbourne was a frequent contributor to this Journal, his articles being informative, clear and lucid. He contributed as well to the Journal of the Royal Society of Western Australia, in association with Mr. W. M. Carne, a paper on the occurrence of natural crossbreds in oats and barley.

A member of the local Agricultural Society, the R.S.L., and Toc H., he carried with him a characteristic thoroughness of purpose, though of a quiet and unassuming nature. He was of unswerving loyalty to his friends, and during the latter years of his life his fortitude and determination when faced with declining health, as a result of his war injuries, were an example to all. His work will be long apparent, and his memory cherished by his fellow officers.

To the bereaved of both these men we extend our heartfelt and sincere sympathy.

HORTICULTURAL NOTES.

GEO. W. WICKENS,
Superintendent of Horticulture.

Once again fruit trees and vines are rousing from their winter resting period, and are decking themselves in spring attire preparatory to commencing the important work of fruit production in the ensuing summer, and growers whose livelihood depends upon the resultant crop watch the changing beauty of young buds to bursting blossoms and tender green growths with mixed feelings of appreciation, apprehension and hopefulness, appreciating the beauty, fearing that some untoward circumstance may prevent fruition, but hoping that good fortune will attend, and the crop be a bumper one. Only those who have been intimately acquainted with the expectations and disappointments associated with deriving a living direct from the produce which Mother Earth can be coaxed into yielding, know the anxiety at this time of year connected with the thoughts of—"What will the harvest be"? No one is well equipped for the business of growing fruit unless he has an abundant capacity for faith, hope and work, and though work is the essential one of the three, it becomes impossible without faith in its performance, and hope for profitable results.

So far as orchards and vineyards are concerned, there is no period of the year when it is hard to find a job requiring immediate attention; but if there is one season more stressful than another it occurs during spring and early summer, when ploughing, manuring, cultivating, hoeing, spraying, thinning, grafting, budding and a long list of etceteras all call for action, and the work entailed must be carried out to a rigorous time-table set by the exigencies of the season, necessitating on the part of the man on the land not only a capacity for work, but method in handling it, so that each activity is attended to at the proper time.

Spraying pear trees to control scab—*venturia pyrina*—is an operation which, if not done at the correct time, no amount of work at a later date will give satisfactory results. Pears sold well on the London market, both this year and last, and in both years considerably more would have been available for shipment if scab had not injured the fruits. This disease has been so long with us that I think the methods of treatment are well known by all growers, but if there are any who are in doubt, and they write to this Department, a leaflet by the Plant Pathologist, Mr. H. A. Pittman, containing full information, will be posted.

Fruit Fly is still with us, and though large areas of orchards in the South and South-West remain free, a considerable toll is taken annually in places within 60 miles of Perth. Constant attention in gathering and destroying all infested fruit from the trees and ground, in addition to trapping and baiting, will hold the pest in check and prevent serious losses, but the work in this connection must be carried out with the regularity and constancy of the operations on a well-conducted dairy farm, or the pest will gain control instead of the orchardist.

In citrus groves orange aphis will require spraying where it is sufficiently numerous to destroy the blossoms. Black Leaf 40, or similar nicotine sprays, are effective, but the pest often re-appears, and more than one application is then necessary.

Red Scale is one of the worst scale insects that prey on citrus trees, but, fortunately, it is largely held in check by parasites in Western Australia. Occasionally, however, the pest increases sufficiently to cause damage, and when this occurs the worst infested trees in the orchard should be sprayed, leaving those less heavily attacked to carry on the parasite. As evidence of the good work that has been

performed by these beneficial insects, I may mention that for many years past no regular spraying nor fumigating has been done in the great majority of our citrus orchards, but Red Scale is now far less in evidence than it was at the time when annual treatment was necessary.

Fortunately, no sign of apple scab was found this year in the two orchards—one at Manjimup and one at Porongorups—where the disease was found two seasons ago, and it looks as though Western Australia is again free from this scourge of the apple grower.

Codlin Moth, also, has made no appearance for two years, and as this has obtained without any control treatment being carried out in any orchard during that period, it is safe to say that Western Australia is again free from the pest until such time as it once more finds an entrance from outside.

Vignerons are not without their disabilities in the shape of diseases, Anthracnose and Oidium being amongst those that require attention, the former now, and the latter later in the season.

Thinning of all kinds of fruit is an essential orchard operation that is often sadly neglected, yet there is no other that pays better. A leaflet on the subject can be obtained at this Department.

I have not dwelt in these notes on the methods of carrying out the various operations, either cultural, spraying, grafting, or budding, etc., referred to in the commencement. To do so would practically mean a treatise on fruitgrowing, but in each district there is an orchard supervisor who is only too willing to advise on any subject connected with the industry, and it is hoped that orchardists generally will fully avail themselves of this service.

In conclusion I would like to express my hope that the promise of spring will be followed by an abundant harvest and payable prices.

"TOXIC PARALYSIS" OR BOTULISM IN SHEEP AND CATTLE.

A. McK. CLARK, L.V.Sc.,
Chief Veterinary Surgeon.

The attention of sheep and cattle owners is drawn to the presence of this disease, which is the cause of serious mortality amongst their flocks and herds during the summer months. It is especially in evidence in the Wheat Belt. The losses are considerable, and it may even be said that toxic paralysis takes the greatest toll of all diseases during the year. The purpose of this article is, therefore, to give due warning to those owners whose sheep and cattle have been, or may be, affected with this troublesome disease in order that steps can be taken to prevent losses from this cause during the coming summer. The reason for toxic paralysis becoming more evident last summer is attributed to the following reasons:—

(1) Long dry summer—(Lack of minerals in pasture).
(2) Lighter distribution of superphosphate—(Less mineral in the soil).
(3) Greater number of dead rabbits—(Infected carcases available for ingestion).

Causes.—This disease is prevalent in many of our districts amongst cattle owing to a mineral deficiency in the food supply. Milking cows in particular constantly require supplies of phosphate in order to remain healthy. Cattle will

attempt to make good their mineral requirements, when pastures are deficient, by chewing bones, which are rich in the necessary elements. If mineral deficiency is very marked the animal's appetite becomes more and more depraved, with the result that all kinds of rubbish is eaten. There is in most districts a germ (*Bacillus botulinus*) which occurs in the soil and infects carcases of animals—cattle, sheep, rabbits, etc. It is found, and, by reason of its great resisting powers, may remain for considerable periods, in bones of dead animals. This bacillus or germ produces a powerful toxin or poison. When the bacilli or toxins are ingested (with bones or parts of carcases which are infected with them), particularly by cattle, in the great majority of cases fatal results ensue. Carcases of animals which have died from the disease are, of course, very dangerous. The disease produced is sometimes known as "Dry Bible" or "Toxic Bulbar Paralysis."

The rabbit carcase-eating habit is developed in sheep owing to continued feeding during the long dry summer on stubble and other pastures which are deficient in phosphates. It will not become evident in the winter months, but usually in the middle or end of the summer.

In order that this disease may occur on a property two factors are essential—

(a) Mineral deficiency.

(b) Presence of bacillus botulinus.

The following diagram will explain the cause at a glance:—

Deficiency of Phosphate in soil produces		Germ in Soil
Deficiency of Phosphate in feed produces		Decomposing carcases
Carcase or bone chewing	PLUS	Toxic carcase

Toxic Paralysis (Botulism).

SHEEP.

Symptoms.—Sheep mostly affected are young sheep and in good condition. In some cases the initial symptoms appear to be wriggling of the tail as though fly-blown. Later they show a stiff gait and a disinclination to move, progressing only for a short distance and then lying down. The animal appears dull and does not attempt to eat. When standing, the head is held in a drooped position, frequently with the lower jaw hanging down. From the open mouth a more or less profuse flow of saliva occurs. In advanced cases respiration is spasmodic and abdominal. Finally the animal is unable to rise, and dies quietly without a struggle. The mortality is usually in the vicinity of 10 per cent.

Prevention (Remedying deficiency).—Cure by treatment is not known, therefore preventive measures, which are known to be successful, should be adopted. It is essential that the full mineral requirements of sheep during the summer months be supplied in order that the craving for rabbit carcases and other debris be satisfied. It is estimated that the optimum daily intake of phosphoric acid for two-tooth ewes weighing 80 lbs. is about $\frac{1}{8}$ oz. For 100 sheep for a week this

would be $5\frac{1}{2}$ lbs. The amount of phosphoric acid which 100 sheep would obtain, in one week, from our summer pasture, is about 3 lbs., and in parts of the wheat belt may be even less. This leaves a deficiency of $2\frac{1}{2}$ lbs. of phosphoric acid. This would be provided in 14 lbs. of dicalcic lick having an 18 per cent. phosphoric acid content. This should, therefore, be taken as a minimum amount of lick to be provided in the wheat belt. That is approximately $\frac{3}{8}$ oz. of dicalcic lick containing not less than 18 per cent. phosphoric acid per sheep per day.

Oats.—Oats are often fed to sheep in this State, and it is interesting to note the phosphoric acid content of this important feed. 1,000 lbs. of oats contain 8 lbs. of phosphoric acid. If oats are fed at the rate of 1 lb. per sheep per day they will supply in one week to 100 sheep about $5\frac{1}{2}$ lbs. of phosphoric acid; this is the required amount of minerals.

Licks.—The question is, therefore, "What lick to use?" It has already been pointed out that this should be a *dicalcic lick containing not less than* 18 *per cent. phosphoric acid.* Bone meal has been used with success for this purpose, but it has been shown by recent investigations that dicalcic phosphate, weight for weight, is three times as effective as bonemeal. Therefore dicalcic phosphate is the most economical and efficacious mineral to use as a lick for the purpose of supplying the necessary minerals to sheep in order to prevent that craving for carcases and debris, and consequently prevent infection with the germ which is the direct cause of toxic paralysis. It is recommended, therefore, that sheep on the wheat belt be supplied with a lick, during the summer months, which can be made up as follows:

Commercial dicalcic phosphate	45 parts.
Commercial Salt	40 „
Molasses	5 „
Water to condition	10 „

In addition, of course, all rabbit carcases and bones should be collected and burned or buried deeply.

This lick is odourless and devoid of any taste and its purity is unquestionable. It should be supplied in wooden containers and placed near the water supply. If sheep are unaccustomed to licks, care should be taken to make them familiar with them. Should they disregard them the addition of a little oats or wheat germ will attract them. This may be excluded after the sheep take freely to them. It may even be necessary to yard the sheep at night, at the same time placing the licks in the yard with them. Phosphatic licks should not be taken away from sheep as a matter of course at the beginning of the winter, but should be continued until the sheep refuse to take them. In all cases they should be made available each year not later than September. It must be pointed out that where toxic paralysis is prevalent amongst sheep a lick containing not less than 12 per cent. phosphoric acid would be necessary in most cases. Also that because licks are taken freely is no indication as to their efficacy.

Other Beneficial Effects.—Apart from the losses sustained by sheep contracting toxic paralysis through the ingestion of infected material, a lack of phosphates in the food supply decreases the food consumption, with the result that an economic loss ensues through the sheep not making the best use of the available pastures.

CATTLE.

Symptoms.—Dairy cows are particularly affected, whilst depasturing; cattle during the summer months are affected to a lesser extent. Cows at the height of milk production require large quantities of minerals for milk secretion. The symptoms produced are due to paralysis of certain portions of the nervous system by

the toxin (or poison) of the invading bacillus. In typical cases the animals are unable, or with difficulty, to masticate or swallow feed. In the early stages there is difficulty in drinking, later no feed or water is taken. There is excessive salivation and sometimes protrusion of the tongue. The gait is more or less staggering (partial paralysis), and the animal is dull. Rumination (cudding) is disturbed and finally suspended, and the faeces are scanty. Progressive weakness ensues, the animal lies down and can be got to rise only with difficulty or not at all. Eventually, in from two days to a week after symptoms are first noticed, the animal sinks into a state of coma (sleep) and dies. These characteristic symptoms are not always shown. In very acute cases death is sudden; other cases may be of longer duration than described, the affected animals showing general unthriftiness, loss of condition and a cripply gait. The bone-chewing habit is constant in all cases.

Prevention.—As treatment is of no avail, preventive measures should be adopted. In mild cases assistance can be given by giving a drachm of powdered Nux Vomica in the food supply three times daily. Drenching should not be attempted owing to the inability of the animal to swallow and the consequent possibility of choking.

Licks.—Prevent mineral hunger and the consequent depraved appetite by supplying phosphates. Bonemeal has been successfully used in the past but a cheaper substitute is now recommended, known as dicalcic phosphate. The latter is three times more effective in similar weights as bonemeal. Dicalcic phosphate should be given in quantities of 2 oz. per cow per day in the food supply, or in the form of a lick which is made up as follows:—

Commercial dicalcic phosphate	.. ..	45 parts.
Commercial salt	.. ..	40 „
Molasses	.. ..	5 „
Water to condition	.. ..	10 „

In the event of this lick not being freely taken by cattle, a little linseed meal should be added only until the necessary liking is developed.

All carcases and old bones should be removed from the paddocks which are carrying stock and buried deeply, or preferably burned.

MAIZE—THE KING OF FODDER CROPS *

GEO. L. SUTTON,
Director of Agriculture.

The maize plant has been described by Henry as "The Imperial Agricultural Plant of America," and in that country it is certainly the "King of Fodder Plants."

Under suitable conditions and when sown thinly a heavy crop of grain is produced, and when sown thickly little grain is produced but a heavy yield of succulent fodder is obtained, and this can be made into bright and nutritious but coarse hay or the best of silage. Even the stalks from which the grain has been removed have a feeding value of about one-third the total food value of the whole crop at the time of removal. The stalks from which the cobs have been removed are known as "Stover" in distinction to "Fodder" maize, which applies to the stalks either green or dry, and from which the grain, if they carry any, has not been removed.

* Reprinted and revised from the article with the same title published in the Journal of Agriculture, W.A., September, 1924.

In the Dairy Belt there is ample room and need for rapid expansion of the cultivation of the maize plant as summer fodder. This is specially valuable, for it provides the means by which the dairy farmer can ensure adequate supplies of succulent fodder during the dry summer months, and further, it is complementary to the clover hay which can be so readily produced and conserved. On non-irrigated land it is reasonable to expect, with good cultivation, from 9 to 15 tons per acre. In the crop competitions conducted by the Department of Agriculture on such land the yields of fodder maize ranged up to 19½ tons per acre. Fodder maize, by supplementing the grazing on established pastures during the summer months, provides a means whereby progressive dairy farmers may increase the carrying capacity of their holdings.

The whole of the plant is useful for stock food—no part except the roots need be wasted. It can be used at any stage of its growth, but supplies the maximum amount of food material when almost mature; at this stage it furnishes a very large quantity of greenstuff suitable for the bulky part of the ration for dairy cattle or idle animals.

The maize grain when ripe furnishes a concentrated stock food, hard, rich in starch and oil for producing heat and energy, and therefore admirably suited for hard-working animals, especially in winter. The grain is comparatively low in protein and ash, and is therefore not suitable for feeding alone to young animals and milking cows; if it is to be used for this purpose it requires to be mixed or balanced with foods rich in protein like clover, lucerne, linseed cake, or bran. Broadly, there are three colour types of grain, viz., *Yellow*, *Red*, and *White*. This difference in colour may on occasion have an important bearing upon the nutritive value of the respective types on account of their vitamine content. All types are fairly rich in vitamine B, but coloured maize grain contains in addition the vitamine A. It is essential, therefore, that animals which are being fed on white maize should also receive as part of their ration some food containing vitamine A, as milk, lucerne hay, or green fodder, or pasture of some kind.

The maize plant is botanically known as Zea mays—hence the common name "maize" by which it is known in this State. It is a native of the warmer parts of Central America, and in that country is usually referred to as "Corn," just as wheat, the staple grain of Britain, is also known as "Corn." To distinguish it from wheat, where there is likely to be some comparison between the two grains, it is called "Indian Corn," the term "Indian" being used because the early American settlers and explorers found the American Indians cultivating this plant, the grain of which was used by them largely as Europeans use wheat.

The maize plant grows to a height of from two to 18 feet, according to variety and conditions of soil and climate under which it is grown. The stem or stalk has joints or nodes like the straw of wheat and oats, and this when mature has a pithy interior, which is covered with a thin layer of hard glossy material. Broad succulent leaves are found growing along the stem, a single one growing from each joint. The stalk as it reaches maturity ends in what is known as the "tassel," and this is the male portion of the flower. The other portion of the flower is known as the "silk," and consists of a mass of fine silk-like hairs enclosed in a covering known as the "husk," and in which the grains produced are formed. The "silk" being located below the "tassel," the pollen of the latter is blown about in the air so as to provide the opportunity for it to fall on the "silks," and if the conditions are favourable these are fertilised. Each silk extends back into the husk and to what will eventually become a grain of "maize" if fully fertilised. The grains when developed are arranged around a cylindrical central portion known as the "core" or "cob," and this with the grains attached is known as an "ear" of maize. A badly fertilised "ear," which has only a few grains on it, is known as a "nubbin."

Varieties—The number of varieties of maize is almost legion. From the farmers' standpoint they differ mainly in their period of maturity, their vigour as represented by the height of the stalks, and in the colour of their grain—white, red or yellow.

Experience in this State indicates that early maturing varieties have been found to be most suitable for our conditions, and "Hickory King," with white grain, and "Leaming," with yellow grain, are recommended.

Climate and Soil.—The maize plant, being indigenous to the warmer parts of South America, thrives best under warm moist conditions, and, as might be expected, it is killed by frosts. It will resist drought, however, if the ground is in good condition and well cultivated between the plants until the tasselling period. The experience already gained in this State conclusively demonstrates that it can be grown in the Dairy Belt.

The most suitable soil for maize is a deep sandy loam well charged with organic matter, such as is found in alluvial flats along river banks, and at one time it was considered that maize could only be grown profitably on such soils. It has been found, however, that new and improved varieties, *e.g.*, Hickory King, already referred to, will grow on a variety of soils, and on those which at one time were regarded as quite unsuitable, provided the land is thoroughly prepared, suitably manured, and the soil between the plants properly cultivated during the growing period.

For the production of grain the critical period is the tasselling stage, and favourable weather and abundant moisture at this time are essential for heavy grain crops. In districts with a limited summer rainfall these conditions are ensured by means of irrigation or by the selection of land known as "summer" or "moist" land, and which has subsoil moisture within about one to two feet of the surface. An irrigated crop is shown in the illustration herewith. It was grown by Mr. E. Forrest, Picton House, near Bunbury.

Preparation of Seed Bed.—Maize is deep rooting ; the soil should therefore be deeply prepared ; on average soils the depth ploughed should not be less than five inches and may reach eight inches. It should be *thoroughly* done, for no amount of cultivation after the crop is up can compensate for the lack of thorough preparation. If possible the ploughing should be done some time before the planting so as to give the soil opportunities to mellow, This is particularly so in the case of heavy clay lands, which will benefit considerably by being exposed to the action of frost during the winter. After ploughing the ground should be brought to a fine tilth by the use of harrows, including the disc harrow, if necessary, to deal with and pulverise pasture land. If the ground is at all cloddy the lumps will require to be broken with a roller or clod crusher. This latter can be made by bolting three of four two-inch planks about five feet long weatherboard fashion on to bearers. On loose sandy land the roller will be useful for compacting the seed bed.

Planting Period.—The time for planting will depend upon the climate of the district in which the crop is to be grown, as maize will not stand frost. It should therefore be planted late enough to escape late frosts in spring and early enough to miss the early frosts in autumn. In the main part of the dairy belt the month of October will be found safe for early planting, and at the Denmark Stud Farm it has been found practical to plant as late as January for maize for silage—the usual planting date for the silage crop being the first week in January. Between these two dates there is a wide range for planting at intervals to secure a succession of green stuff for dairy purposes. It is anticipated, however, that November will be found the most suitable month for the main planting throughout the Dairy Belt.

Seed Selection.—At one time it was thought that grain from the middle of the cob was better for seed purposes than that from the pointed end or "tip," or from the "butt," *i.e.*, the end to which the husk is attached. Numerous experiments however, have shown that, as far as the resulting yield is concerned, it is immaterial from which part of the cob the seed is taken. That from the middle, however, has the advantage that it is more regular in shape and size, and, therefore, more suitable for machine planting.

Seed maize sometimes carries in it the mycelium of a fungus disease known technically as *Fusarium* sp. or *Diplodia* sp. and popularly as the "Seedling Blight" of Maize. It is so-called because its effect is to cause the seedlings to blight or wilt off. Some plants, after being attacked, may survive and reach maturity but they are always weak. Unfortunately, there is no known method of control which is readily available to local growers for treating the seed, and the only preventive is to secure seed from crops which have not had the disease. Such seed will only be available when growers generally create a demand by asking for it. When known non-infected seed is not available, the means to combat this disease are thicker seeding in the row or hill and the maintenance of high soil fertility supplemented by liberal manuring with superphosphate.

Irrigated Maize, Picton, W.A.

Treatment of Seed.—Sometimes birds, *e.g.* crows are troublesome and follow the drill marks and pull up the seed after it is planted. To prevent this the seed is coated with coal tar by pouring coal tar over the grain at the rate of one pint to the bushel, and then stirring it with a stick until the grains are evenly covered. When covered they are dried for planting by mixing with sand or ashes. Seed disinfection with organic mercury compounds, such as "Bayer dust" and "Improved Semesan Junior," has given good results in controlling many seed-borne diseases in the United States of America, but unfortunately these substances are not at present on the market in this State.

Rate of Seeding.—The practice of sowing maize broadcast is almost universal in Western Australia. Such a method is, however, no longer in accordance with

modern practice in the Eastern States and the United States of America, and it is desirable that it should be discontinued here, even when intended for fodder purposes only.

Maize intended for grain is planted in either drills or "hills"; under the former method the single plants are grown at regular intervals in rows, under the latter two or more seeds are planted at regular intervals in rows in holes or "hills." It has been found inadvisable to have more than four plants in a "hill," and the common practice is to have three. Experiments have shown that there is little or no difference in the yield whether maize is planted in "hills" or drills.

The "hills" are said to be checked when the hills are in lines across the rows as well as in the rows, just as in many orchards the trees are in lines in two directions, one at right angles to the other. The checked hill method has the advantage of allowing the land to be cultivated two ways, and thus facilitates the destruction of weeds in dirty paddocks. To enable the proposed crops to be planted according to this system, special appliances called "check row" attachments have been devised for use with double-row planters. When a machine-planter with such an attachment is not available, a common plan is to strike out furrows across the length of the paddock the distance the rows are intended to be, and then plough out other furrows running across the width of the paddock, and sow the seed (say four grains) where the furrows intersect one another.

Great variation has been obtained in America and Eastern Australia with regard to the number of plants to the acre, and has ranged almost all the way from 5,000 to 50,000 per acre. The drills have varied from three to five feet apart, with single grains one and a-quarter to four feet apart in them. The closer distances usually give the greatest yield of food material, but with smaller cobs and more "nubbins." When the crop is grown for grain the husking of the smaller ears increases the cost of harvesting, and so the happy mean between high yield and low cost of husking is sought.

There will always be some variation in the number of plants per acre necessary for best results, on account of the difference in varieties and climate. As the result of many experiments the tendency now, however, is to maintain a uniform distance between the drills about 40 inches, and to vary the distance between the plants in the drills. It is believed that under Western Australian conditions maize planted in drills about three and a-half feet apart with single plants 12 to 15 inches apart will give best results for grain, and with plants four to six inches apart best results for fodder or silage. At these distances the amount of seed required per acre will be—for fodder or silage, 14 to 18 lbs.; for grain, six to eight lbs. If planted in "hills" it is recommended that the "hills" be three and a-half feet apart each way, with three grains to the hill.

Depth of Plant "Listing."—Maize being a large seed, quite a considerable percentage will grow if planted four and five inches deep, but from two to three inches deep is considered the best depth to sow. It throws out brace or secondary roots as well as primary ones, the object being to resist the effect of heavy winds on such a tall plant. It is considered desirable to have these roots well below the surface, and it may be thought this can be accomplished by planting deeply. This, however, is not so, for no matter how deep the planting, the secondary or brace roots will grow just below the surface, whether planted as deep as six inches or as shallow as two inches. To overcome this characteristic the practice of planting the seed two inches deep at the bottom of an open plough furrow, and then to fill in the furrow by successive cultivations as the plant grows, is sometimes adopted. This method is known as "listing." It is claimed by its advocates that a "listed" crop will stand drought better than one planted on the level. Sometimes such a method is necessary during a dry spell in order to reach the moisture necessary for

germination. This was the case at the Denmark Farm last season, and as a result it was practically the only crop fit to harvest in the district owing to an abnormally dry summer.

Maize Planting Machine.—Single and double row maize machines for planting are now available. They are expeditious and do extremely satisfactory work. They are designed to sow the seed in "hills" or single grains at regular intervals, and with suitable plates can be used to sow seeds as small as turnip seed or as large as French beans. They are also fitted with an attachment for applying the fertiliser, and with a device for marking out the line for the driver to follow when planting the next row or rows. These machines open the furrow, drop the seed, cover and press the seed into the soil in one operation. This last operation of pressing the seed into the soil is of considerable importance, and is done by the rear or driving

Single row Maize Planter.

wheel, which has a concave surface. The best machines have what may be described as a "split" covering wheel, that is, the iron rim is in two pieces with a space of about three-quarters of an inch between each side. If the surface of the covering wheel is unbroken all the soil above the seed is compacted or firmed, whereas if there is a space between the two edges the soil immediately above the grain is loose, and does not become badly crusted if rain falls before the seed shows above the ground.

Because of the importance of pressing the seed into the moist soil, to assist germination, hand planted seed should be pressed with the foot as it is dropped.

Single row planters can be drawn easily by one horse, but when the machine is used with the marker on, it runs more smoothly, and is less strain on the driver if a pair of light horses are used. About seven acres is a fair day's planting with a single maize planter with drills three and a-half feet apart.

Manuring.—Unless it is intended to replace all the plant food removed by the crop, the system of manuring will be governed to some extent by the character of the soil on which it is grown, for under other conditions the farmer will desire

to utilise some of the latent fertility of the soil. As a guide to what may be expected in this connection it may be stated that sandy soils are deficient in practically all the elements of plant food and peaty or swamp soils deficient in the mineral constituents (phosphoric acid and potash), whilst clay soils are usually well supplied with potash.

Because of the large tonnage produced, a crop of fodder maize removes from the soil a very considerable amount of plant food. A 10-ton crop, which is only a fair one, will remove about 80lbs. of nitrogen, 30lbs. of phosphoric acid, and 70lbs. of potash. Of these constituents nitrogen is much the most expensive, relative rates per unit being: nitrogen 12/6, phosphoric acid 4/2, potash 7/4. *To suplpy the whole of the quantity of nitrogen required by means of commercial fertilisers is economically impossible. Fortunately it can be supplied indirectly and without cost by sound farming methods, as the result of growing a legume, *e.g.*, subterranean clover, to precede the maize crop, for legumes have the ability to collect and store up this valuable plant food from the free nitrogen present in the air. Subterranean clover is a legume, and grows most luxuriantly throughout the Dairy Belt. It should therefore become an established practice to arrange that the maize crop follows clover pasture after the second or third year, though this is not so necessary in peaty soils. When maize is to succeed clover the land should be ploughed up sufficiently early in the winter to enable the clover roots and stubble to become partially decomposed and incorporated with the soil before the maize is planted.

Farmyard manure or any coarse manure can be applied with very great advantage and in any quantity with perfect safety to this crop. There is no danger of heavy dressings injuriously affecting maize, as would be the case if applied to the wheat crop in the Wheat Belt. Nor is there any need to wait until it rots before spreading it on the land intended for maize, for the cultivation which must be given the maize crop will destroy the weeds which may grow from the unrotted manure. It can be spread with advantage on the subterranean clover or legume sod as fast as it is made and ploughed in at convenient times. The maize plant, because it is a gross feeder, can make use of the coarse unrotted manure, and it is assisted in this direction by the fact that it makes most of its growth during the summer when nitrification and other natural agencies are most active, and in consequence a larger proportion of the plant food constituents are made available than would be the case if the crop were grown in the winter.

Because of their usual deficiency in phosphoric acid, it is probable that on all our soils it will be advisable to supplement the application of stable manure, and the plant food accruing from the turning in of the clover sod with an application of superphosphate, and on sandy and peaty swamp soils with some potash.

Pending the securing of definite local information regarding the crop requirements under our conditions of soil and climate, it is recommended that the fertiliser used on clay and alluvial soils which are usually well supplied with potash be 2½ cwt. of superphosphate per acre. On sandy, peaty and swamp soils, which are usually deficient in potash, an addition of ½ cwt. of sulphate or muriate of potash per acre to the superphosphate is also recommended. If the maize be planted on land other than peaty or swamp soil which has not had subterranean clover or other legume preceding it, it will be advisable to add at least a half cwt. of sulphate of ammonia per acre to the above fertilisers. With this latter addition the fertiliser will be of similar composition to the Potato Manure E put up by the fertiliser firms.

* A fertiliser unit is 1% or 1/100th part of a ton and is, therefore, equal to 22·4lb. (nearly 22½lb.). Just as a stone of 14lb. is a conventional term used in connection with the sale of potatoes, so unit is a conventional term used to facilitate easy calculation when reducing the prices of fertilisers to a common basis for comparative purposes.

The fertiliser can be applied at the time of planting, but as it is risky to have potash fertilisers in direct contact with the young rootlets, provision should be made to prevent this either by stirring the fertiliser into the soil before the seed is planted or by some other method.

Cultivation after Planting.—Much if not the whole of the success which will attend the cultivation over a large part of the Dairy Belt will depend upon the cultivation given to the soil after the crop is planted. A huge crop—up to 20 tons—which the maize plant is capable of producing in a short time, requires a considerable quantity of moisture and plant food. By cultivating the soil between the rows of plants, the weeds which would rob the maize of both moisture and food are destroyed, the moisture is conserved by reducing the loss resulting from evaporation, and the soil is aerated and the natural agencies stimulated to make plant food available. Realising these facts, it can be readily understood how important a part "intertillage"—or cultivation between the drills—plays in the production of this crop, and especially where the summer moisture is limited. It may

Single row Maize Cultivator

be advisable to cultivate the soil before the young plants have appeared above the ground, if warm rains have occurred and the weeds are germinating rapidly. Such instances are likely to be rare. Almost invariably, however, it will be found that intertillage is desirable as soon as the rows of plants can be seen, and this should be continued as often as may be necssary to keep down weeds and maintain a loose layer—a "blanket mulch" of earth on the surface.

The cultivations should begin soon after the seed is sown and continue until the nearly as high as a man's head. A light spike tooth harrow can be run over the crop until the plants are about six inches high, after which a single horse cultivator, which will go between the rows or a two-row cultivator, which will straddle the rows, should be used. The depth of cultivation should be from two to three inches Deeper cultivation is likely to injure the roots which grow within a few inches of the surface and soon extend from row to row.

Under most conditions three or four cultivations will be sufficient, though occasionally more will require to be given. A badly prepared seed bed, a heavy growth of weeds, and frequent showers will increase the number necessary for the best results.

For areas up to 10 or 15 acres the single horse hoe or cultivator, similar to that shown in the illustration, is very suitable. This is light to handle, and with practice a smart driver can become so expert as to destroy frequently weeds which may be found growing between the individual plants in the drill.

For larger areas than 15 acres a double-row cultivator of the same type, and which will straddle the rows, can be obtained.

Harvesting.—When required for grain the most common practice is to allow the crop to stand in the field until the grain is quite ripe, a condition which is indicated by the husks becoming dry and hanging down. These are then gathered by hand and husked in the field or in the barn.

Unless the grain is quite dry when gathered it should not be stored away with the husks on, as it is likely to heat and mould. Until thoroughly dry the cobs can be stored only in open sheds which admit of a free circulation of air.

After the ears are husked and the grain thoroughly dry, they require to have the grain shelled off them. This is done slowly by holding the cob in one hand and forcing the grains off with the thumb and palm of the other hand or by the core of another cob. Shelling is done more expeditiously by maize shelling machines operated by hand or power.

The maize grain is a very concentrated form of food, similar in value to wheat. On account of its hard character it is usually cracked before being fed to stock. It is extremely useful for feeding to farm horses, and has not the same injurious effects as is experienced with wheat. Large quantities are, however, somewhat heating, though in some parts of the Eastern States it is practically the only grain fed to horses which are working hard.

For the best results, as a concentrate for milking cows, it requires to be mixed with some more nitrogenous food, such as peas.

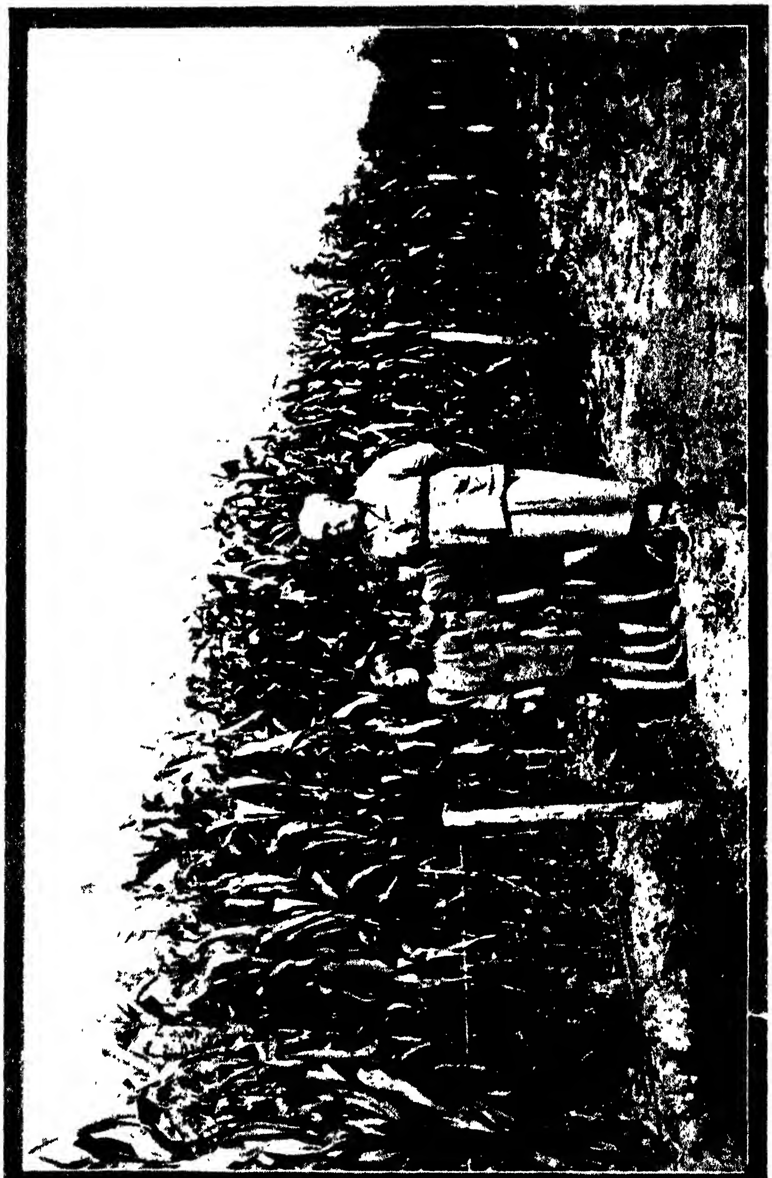
For pig raising, the twin ally of milk production, maize grain ranks very highly and is complementary to the separated skim milk left on the dairy farm, as this is rich in proteins and ash, and in consequence balances the maize, which is rich in carbohydrates.

The "core" or "cob" has a slight feeding value. Some farmers grind the whole of the ear, *i.e.*, the grain and the cob, together, and the meal thus produced is then known as "Corn and Cob" meal. It is difficult and expensive to grind the "core" to a reasonable degree of fineness, and it is somewhat doubtful whether the feeding value of the "core" is worth the cost of grinding. In this connection it is believed that the principal function of the "core" in such meal is to lighten the mixture, thus facilitating the digestion of the ground corn grain.

The unit by which maize grain is sold is the "bushel". The bushel proper is a measure of capacity, but maize is not measured but weighed, and the term "bushel," as understood in connection with maize, is a conventional one and means 56lbs., which is the approximate weight of a measured bushel of grain. To sell a bushel of maize is therefore to sell 56lbs. weight. About 75lbs. weight of "ears" will produce about 56lbs. (1 bushel) of grain.

The stalks and leaves—"stover"—which are left after the "ears" have been removed contain about one-third of the total food produced by the plant. Therefore much will be lost if this is not saved. If left in the field its food value rapidly

diminishes. Because of this the more modern practice is to cut the crop (stalks and grain), after the grain has commenced to colour and dent, and tie the bundles and stook them until the grain is dry and the stalks cured, say, five or six weeks. The cobs are removed and the fodder stored away until required.



A Non-irrigated Fodder Maize Crop, Busselton.

The "stover" is not as valuable as the maize fodder (green stalks with unhusked cobs attached) but is very useful for idle horses, and for the maintenance of dry cattle over the winter. Its value is enhanced when the stalks are run through a chaff-cutter or shredded, *i.e.*, dealt with by a machine which tears the stalks into

strips or shreds, and known as a "shredder." Machines are now available which will take the corn stalks with cobs attached and deal with the whole material, husking and shelling the cobs and shredding the leaves and stalks in one occupation.

Henry, in his "Feeds and Feeding," has pointed out that the results of experiments conducted by Ladd, at the New York (Geneva) Experiment Station, show that the nutrients in a crop of maize increase very considerably from the time of tasselling to maturity. When tasselled the crop weighed nine short tons (18,045lbs.) more than eight of which were water. The weight of the crop continued to increase until the grain reached the full milk stage, after which it decreased. Between the milk and glazing stage there was a loss of water, but a remarkable increase in quantity of nutrients, as shown by an increase of over a ton of dry matter in 17 days. From the glazing period until fully ripe there was a further slight increase in nutrients. The results show that through the various stages until the "glazed" period there is a constant and considerable increase in the nutritive value of the plant. Because of this the crop intended for fodder should not be harvested before the grain is glazed. For silage purposes it should not be delayed beyond this period, as the plants then contain the proportion of water required for good results.

The green crop can then be cut with a short scythe, cane knife, or hoe. For large areas a special machine known as a "maize harvester" is on the market. This machine cuts the stalks and binds them into bundles, just as a reaper and binder deals with the wheat crop. The advantages of such a machine when making silage are obvious.

For silage the green material is placed at once, preferably chaffed, into the "pit," "trench" or "above ground" silo, or unchaffed into a stack. It is important for those who have silos to realise that if desired the material can be used from the silo immediately after being placed therein. In this way the silo acts as a store house to enable a green crop to be harvested at its most nutritive stage, and used whilst in that condition.

The green fodder can be made into good coarse hay, and for this purpose should be tied into handy sized bundles or sheaves, and a number of them, say, five to seven, stooked together in the field until thoroughly air dried. It should then be placed under cover and chaffed before being fed to stock. The disadvantage of making it into hay is the long period necessary for curing—five to six weeks—during which time a considerable amount of food material is lost.

Valuable as the maize fodder is, it must be recognised that it is not a complete food in itself for dairy stock or working animals. Just as bread forms a very solid foundation in the dietary scale of human beings, so maize fodder, whether as silage for milch cows or hay for horses and dry cows, can play a similarly useful part in the rations of farm animals. Even well-cared-for "stover" has a greater feeding value than is generally believed, and is most suitable for idle stock during the winter. All forms of maize fodder can be utilised to supply in a cheap way the bulky and carbonaceous part of the food required by milking cows. To obtain the great benefits capable of being derived from its use with milking cows or young stock, it requires to be fed in conjunction with some legume, such as the clovers or lucerne, which should be grown on the farm to maintain, and even increase, its fertility and at the same time supply the protein and ash, the food constituents in which maize is somewhat deficient.

DOWNY MILDEW OF TOBACCO.

Two Recent Outbreaks near Perth.

SPRAYING AND OTHER NECESSARY PRECAUTIONS.

H. A. PITTMAN, B.Sc. Agr.,
Plant Pathologist.

It is desired to draw the attention of all tobacco growers in this State to two recent serious outbreaks of Downy Mildew (*Peronospora sp.*) (so-called "Blue Mould") of tobacco in seed-beds at Middle Swan and Belmont.

In view of these outbreaks and the extreme seriousness of the disease, tobacco growers in all parts of the State are warned to take no chances of having downy mildew break out on their seedlings, but to spray them as a routine precautionary measure with 4-6-50 Bordeaux mixture at weekly intervals from the time the plants reach the four-leaf stage until they are ready for planting out. After the young plants have recovered from the shock of planting out, one further spraying as above may be given, but should not be required under normal weather conditions, as downy mildew (so-called "blue mould") is essentially a seed-bed disease in this State.

There is a tendency on the part of many growers who disinfect their seed-beds before sowing, and who use disinfected seed, to consider that these two precautions are all that are required to safeguard the plants from this dread disease. Nothing could be more fallacious, as there are so many different and unsuspected ways in which the disease may be introduced on to a property that the only safe procedure is for the grower to assume that it will inevitably occur each year unless the plants in the seed-bed are periodically sprayed with Bordeaux mixture as recommended above. Not to do this is like expecting an army to successfully withstand the onslaught of its adversaries without providing it with any weapons of defence. Bordeaux mixture, properly prepared, and applied as often as is necessary to keep the young growth covered with a thin film of spray (*i.e.*, at about weekly intervals), is an effective defence against the onslaught of many downy mildew fungi; but it is powerless to cure the plants after they have once been successfully attacked.*

OTHER NECESSARY PRECAUTIONARY MEASURES.

Certain other precautionary measures must be taken in addition to those already mentioned, so as to leave no stone unturned in an effort to secure healthy seedlings for planting out. These include the keeping of the surface of the seed-bed as dry as possible, watering the seedlings only when absolutely necessary, and then in the mornings, never at night; the maximum possible exposure of the seedlings to sunlight; *early thinning of the seedlings so as to allow plenty of air and sunlight to surround each plant,* and efficient covering of the seed-beds at night to keep up the temperature and during wet weather to keep the plants dry. Further, the keeping

* Experience in many parts of the world indicates very clearly that "home-made" Bordeaux Mixture has much better fungicidal and adhesive properties than most of the so-called "Bordeaux" proprietary substitutes. In addition, the "home-made" material, if properly prepared, is much less likely to "burn" the plants. The writer recently witnessed a tobacco grower spraying his tobacco seedlings with a proprietary "Bordeaux" which was so useless that, even when applied at twice the recommended strength, no vestige of spray was to be seen on the plants several minutes after it had been applied.

down of insect pests which may introduce the disease from other properties or spread it rapidly when once it has been introduced, should be given attention. Growers should refrain from visiting one another's seed-beds and should plant out

Fig. 1. Under-surface of tobacco leaf badly affected with downy mildew (*Peronospora sp.*), showing the characteristic shrivelling of the affected portions and the very copious production of white, greyish, or violet-tinted fruiting bodies (*conidiophores*) on the under-surface. The lower right portion of the leaf is still healthy.

After Mandelson, Queensland Agric. Journal, August, 1931.

their seedlings as soon as possible, as the disease is usually of very little consequence once the seedlings are planted out.

The covers to the beds should be water-tight and should have a pronounced slope so as to shed the rain outside the beds and keep the plants quite dry during wet weather.

The remains of each season's plants should be destroyed as soon as the final harvesting of leaves is over, so as to prevent the carrying over of the disease from one season to another on over-wintering plants. If this work is left until the heavy autumn rains arrive it is very difficult to successfully burn the old plants. This work should certainly be carried out at least several weeks before any new seed-beds are prepared.

Seed should not be sown too early. In both of the instances referred to in the opening paragraph of this article many of the seedlings were already planted out in the field by the middle of August. On one of the properties seed was sown on the 18th April. This is simply courting disaster. The earliest sowings should not be made before the end of June.

PREPARATION OF BORDEAUX MIXTURE IN SMALL QUANTITIES.

Spraying should not be done during the heat of the day or when the plants are drooping, but during fine dry weather, and preferably in the morning when the leaves are dry.

The directions for preparing approximately 4-6-50 Bordeaux mixture (actually 4-6-48) in small quantities are as follows:—

Take 4 ounces of bluestone and dissolve it, using hot water if desired, in 1½ gallons of water in a wooden, earthenware, copper, bronze, glass, or enamel vessel (metals other than those mentioned should not be used, as they are attacked by the bluestone). In another container of any kind slake 6 ounces of best quality, freshly burnt stone or quick lime in another 1½ gallons of water (air-slaked lime is useless for preparing Bordeaux mixture).

Then pour these two substances, after cooling, simultaneously through a piece of coarse cloth or brass strainer (to remove pieces of grit, etc.) into the spray outfit and apply to the plants immediately, using a fine mist-like spray which will thoroughly cover but not drench the foliage.

If any spray is over after each treatment, it must be discarded, as Bordeaux mixture rapidly deteriorates on standing after being prepared.

A rough but useful test which should always be carried out after the Bordeaux mixture has been prepared and before spraying the plants with it, is to dip the clean blade of a penknife or a bright piece of iron such as a roughened-up shiny nail into the mixture for several minutes. If the mixture, by any chance, does not contain enough lime, a reddish-brown deposit of copper will form on the iron, and more lime should be added until, on further testing with a fresh knife-blade or shiny nail, no stain is obtained. If this test is always carried out before spraying with Bordeaux mixture there need be no fear of burning the plants with the spray.

STOCK SOLUTIONS OF BLUESTONE AND OF LIME.

Where Bordeaux mixture has to be used at frequent intervals it is a decided advantage in many ways to make up stock solutions of bluestone and of lime as follows:—

1. Dissolve any desired quantity of bluestone (say 10 lbs.) in water in a wooden barrel, or earthenware, enamelled, glass, copper, brass or bronze vessel, at the rate of 1 lb. of bluestone to every gallon of water, by suspending the bluestone just below the surface of the water in a piece of sacking from a stick placed over-night across the container. When all the bluestone has been dissolved the solution then contains 1 lb. bluestone to the gallon of solution.

2. Into another container of any kind place a weighed-out quantity of quicklime (say 10 lbs.), then add water little by little until the slaking is completed, and finally add more water to make the final volume of the "milk of lime" equal to the same number of gallons as the number of pounds' weight of quicklime taken (*i.e.*, say 10 gallons). This mixture now contains the equivalent of 1 lb. quicklime to the gallon of "milk of lime."

PREPARATION OF BORDEAUX MIXTURE FROM THE STOCK SOLUTIONS.

To make 4-6-50 Bordeaux mixture from these stocks, *firstly*, take *1 quart* bluestone stock solution and dilute it in a wooden barrel, or earthenware, enamel, brass, copper, glass, or bronze container with water to make 1½ gallons.

Secondly, take *3 pints* lime stock solution, after stirring thoroughly to evenly distribute through the water the lime which has settled, and dilute with water in any sort of container to make 1½ gallons.

Then *thirdly*, pour these two liquids together simultaneously through a piece of cloth or brass sieve to remove grit and coarse particles, thus making 3 gallons 4-6-50 Bordeaux mixture.

Bluestone stock solution prepared as above will keep indefinitely. Lime stock solution prepared as above will keep 12 months with a loss of only ¾ lb. per cent. active lime.

When finished with each stock solution, each time, make a mark at the top of the liquid and replace any evaporated water before using again.

Use a separate vessel for dipping out the required amount of each stock solution, so as to prevent deterioration of each stock.

INCREASING THE SPREADING AND ADHESIVE QUALITIES OF THE SPRAY.

The spreading and adhesive qualities of this spray may be considerably increased by adding ¼ pint of sweet skimmed milk, or ½ to 1 oz. of flour, or 2 to 3 ozs. of good-quality soft soap, or ½ to 1 oz. of calcium caseinate spray spreader, or ½ to 1 oz. of powdered skimmed milk to every three gallons of spray immediately prior to using. In the case of the flour, soft soap, calcium caseinate or powdered skimmed milk, mix up thoroughly with a little water before adding to the spray. Then mix thoroughly through the spray. In the case of the soap it is very important only to add immediately before spraying. All the spraying utensils should be thoroughly washed out after use.

FURTHER INFORMATION.

Further information *re* the downy mildew disease of tobacco is obtainable in leaflets Nos. 329 and 329a, or pages 264-72 and 97-103 of this Journal for June, 1931, and March, 1932, respectively, and on Bordeaux mixture in Leaflet No. 314, or on pages 600-609 of this Journal for December, 1930.

CONCLUSION.

As the writer has always contended (*loc. cit.* previous paragraph) no single measure will of itself suffice for the control of such a serious disease as the downy mildew disease of tobacco. Early destruction of all remains of tobacco plants at the end of the season; eradication of wild tobacco (*Nicotiana suaveolens*) and any

other *Nicotiana* species growing in the locality; the use of healthy seed or seed disinfection; seed-bed disinfection or the use of completely new sed-beds each year; early thinning out of the seedlings so as to have only one plant to every square inch, or, even better, two square inches; the maximum possible exposure of the seedlings to sunlight; watering of the seedlings only when absolutely necessary and then only in the mornings, never at night; keeping up the temperature as much as possible at night; the use of sloping covers to the beds which will shed the rain during wet weather; routine weekly sprayings with home-made Bordeaux mixture; seasonable sowing of the seed, and the planting out of the seedlings into the field as soon as possible after the danger from frost is over; all these operations must be regarded as integral parts of the process for raising downy-mildew-free tobacco seedlings.

The raising of tobacco seedlings is not an occupation to be undertaken by the average "man in the street," or even by the average farmer. It is a job for a specialist.

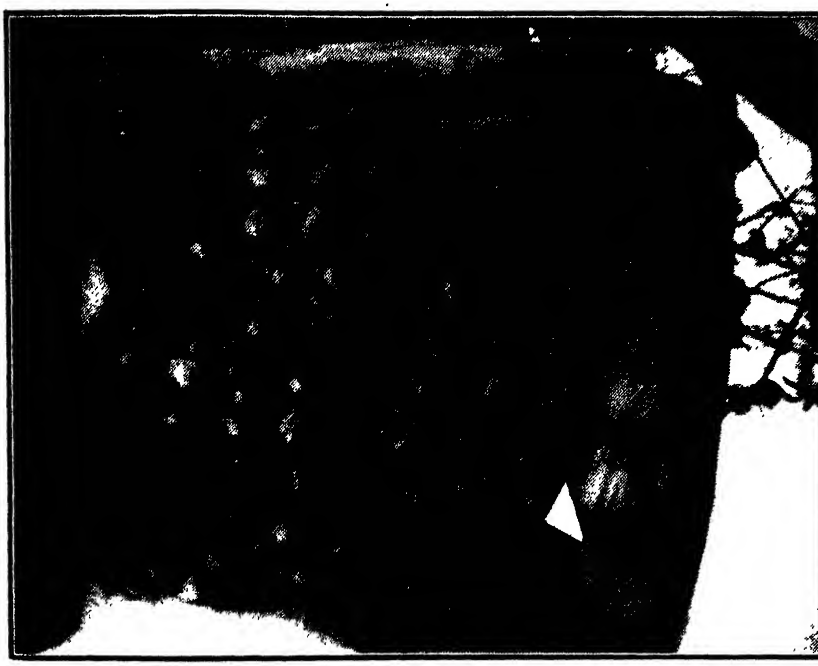
My observation of many tobacco seed-beds convince me that the great majority of tobacco growers have still a great deal to learn as to the production of sturdy tobacco seedlings, quite apart from keeping them free from the ravages of downy mildew.

PASTURE HARROWS.

CHEAP METHOD OF MAKING CHAIN HARROWS FROM OLD HORSESHOES.

H. G. ELLIOTT.

The use of efficient pasture harrows is desirable, and is one of the beneficial features of the new system of pasture management. If farmers carry out the regular and even distribution of the droppings, it results in more even growth as the season progresses and reduces the tendency of having tufty, unpalatable pasture produced.



Chain harrows made from old horse-shoes.

A cheap and efficeint method of making chain harrows out of old horseshoes, for spreading the droppings of animals, has been received from Messrs. Wilkinson Bros., of Millbrook, Albany. The accompanying photograph illustrates the method used for making.

Messrs. Wilkinson Bros. state that to make a set for two light horses to pull easily it requires 277 shoes; these are arranged so that there are 21 across and 17 down.

The shoes are heated and rounded so that the ends are slightly overlapping. Six lengths of plough chain are used for connecting the harrows up with the front bar. At two places, about one-third and two-thirds of the way back from the front bar, spreaders in the form of quarter-inch bars are used. These are comprised of

three short bar lengths joined together by rings. The short lengths allow for the irregularity of the ground when the harrows are in operation. The spreaders are only connected to the outside shoes.

This home-made harrow has been operated very successfully by Messrs. Wilkinson Bros., and they state that it breaks up the droppings of animals that have been out in the paddock throughout the summer months.

CHEAP SILAGE CONSERVATION.

G. K. BARON-HAY,
Superintendent of Dairying.

The climate of the greater part of the South-West agricultural area of this State, resulting in a more or less protracted dry summer, makes it imperative for all farmers to consider means whereby fodder can be conserved for hand feeding during those months of scarcity. For dairy cattle it is imperative that this fodder should be of a succulent nature, so as to replace green herbage as far as possible. The only certain method of carrying this out is by the preservation of winter crops in their green state in the form of silage.

Although overhead tub silos are recommended where they can be cheaply constructed, the writer does not believe this expense justified on a dairy farm in the initial stages of development.

In certain districts where timber is cheap, "face-cut" silos may be economically erected, as described in an article by Mr. M. Cullity in September issue of "Journal of Agriculture," 1930. These silos are common in the Manjimup-Jardee area, which are near to the timber mills with cheap seconds and reject timber available. The following particulars are given by Mr. Cullity.

This silo as erected is square, having usually 8 to 10 feet sides. The construction is very simple, and may be seen in a glance at the accompanying photographs. Four corner posts are erected, round bush poles being just as suitable as sawn timber. Cross bearers are inserted on the inside of the posts in a horizontal position. The face-cuts are then fastened vertically to the inside of these, and arranged so as to have as smooth a surface as possible inside.

The cost of the silo is very small; an idea of it may be obtained from the following figures given by Mr. W. Kjellgren, of Middlesex, Jardee. His silo is 8 feet square and in all is 17 feet in height, but, as it has been erected in an old pit 6 feet deep, it stands only 11 feet above ground. The materials for this were as follows, Mr. Kjellgren making no allowance for his own labour, being concerned only with the actual amount of cash having to be paid out:—

	£	s.	d.
32 face-cuts 17ft. x 1ft. x 1in., at 1s. each	1	12	0
9 feet 4in. x 2in.	0	12	0
Nails, 4 to each board on each batten	0	6	0
	£2	10	0

Labour charges were not made, as Mr. Kjellgren contended that the whole was erected during slack periods, and periods of broken time when no other useful work could have been attempted.

Another farmer using this same type of silo is Mr. W. Cox, of Jardee. In this case the dimensions were 9ft. x 9ft. x 18ft., the bottom of the silo being 4 feet below ground level. The face-cuts used were wider than those obtained by Mr. Kjellgren, being up to 18 inches in width, and the consequence is that more warping has taken place. Mr. Cox intends to either replace these warped boards with narrower ones, or split them, giving a better hold on to the bearers, minimising the tendency to warp.

The cost of this silo without labour charges was £4, including bearers, face-cuts, nails, and cartage from the Jardee mill, approximately six miles.

An illustration of this silo is shown below.

Illustration I.—Facecut Silo erected by Mr. W. Cox, Jardee.

Mr. G. F. Combs, of Jardee, is another who has been particularly successful in using this type of silo. This silo was estimated by Mr. Combs to have cost £7, including the charge for labour used in its construction. This one differs from those previously described in that it is wholly above ground and that, in general, narrower boards have been used, mainly flooring board size.

In 1928-9 season a comparison was made by the writer of the measured loss in these silos as against the measured loss in open stacks. There were some very bad attempts at making silage by both methods, but the worst failure with the face-cut silo could not be compared with the loss made in several stacks.

Much of the loss was caused by lack of knowledge of the process of ensilage, crops being cut too late, left too long before carting in, and bad stacking and trampling being responsible in many cases for building up the waste beyond a reasonable figure.

The summary of the comparison above referred to showed that the average loss in the face-cuts was one-half only of the loss in the stacks. One or two stacks inspected were complete failures, while the worst face-cut was better than the best stack. I am referring here still to the amount of loss, not wishing to make any comparison between the quality of the silage made by the two processes.

The disadvantages most frequently quoted against this system is that of difficulties in filling and emptying. This seems really great, but only then when compared with the stack, and even then the disability appears greater than is actually the case. In the stack the material is forked direct from the cart or sledge on to the top of the stack, while, in the other type, the filling takes place either over the top of the structure or else through the doors which are left in the better type. A whip-stick arrangement is used by Mr. Grumpelt for filling, while Mr. Crawley has a special loading fork and derrick. The unloading problem where doors are left at convenient heights is no different from that of a stack.

A few points that assist in reducing waste by this method are enumerated below:—

1. When wide face-cuts are used, they should be secured to the battens their whole width, otherwise warping will occur which will allow more air to reach the curing silage. Where green boards only can be obtained, it is much preferable to use narrow boards, as the tendency to warp is minimised.

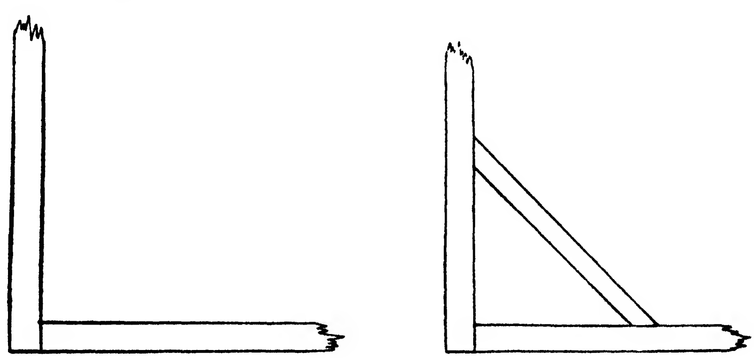


Illustration II.

2. The vertical boards should be as close together as possible so as to exclude air.

3. Where possible it is advisable to have the bottom of the structure below ground, as air is completely excluded in this portion. Four or five feet below ground level is not inconvenient.

4. Some of the waste in the square corners may be eliminated by placing in the angle about the position of the cross bearers a small batten, to which face-cuts may be nailed on the inside, so doing away with the right-angle corner as shown.

The following applies to stack, pit, and other methods of ensiling:—

5. The crop should be cut early. Where ordinary pastures are concerned, cutting may take place late in September or early in October. Less waste will

result from silage made at this season than would be the case with later cutting. Cutting earlier than this would result in a too sappy or mushy silage with a considerable loss in feeding value.

The farmer in any case must arrange his work so that his ensilage season is finished before his paddocks are ready to cut for hay. Once the time for hay-cutting arrives, the farmer's energies are more profitably devoted to making hay.

6. Only as much material should be cut in one day as can be carted in and placed in the silo on that day. The usual method on most small farms is to cut in the morning and cart in during the afternoon.

7. The material first cut should be first carted.

8. In loading the silo, the material should be spread evenly and well trampled, paying most attention to the sides and corners. When leaving at night have some handy weights close by for laying on top. A few planks and sand-bags serve the purpose; when full, cease cutting for a while till subsidence takes place. A convenient method of deciding when the recommence loading is to wait till the heat generated in the material can be felt in the top layer. This applies more particularly to where the material can be carted in fast. This filling and waiting to sink has to be continued for some time. Of course, the more carefully this is done, the more material ensiled and the better the resulting material will be.

Commencing to fill a "trench" or "clamp" silo on property of Mr. Davis, Gnowangerup.

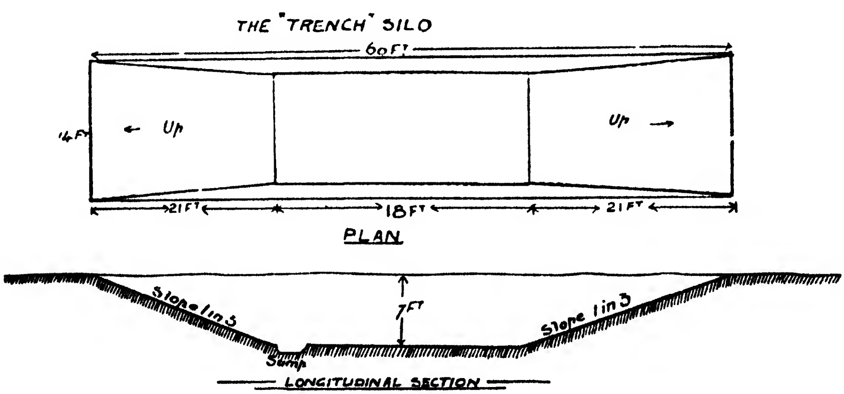
In areas of lighter rainfall or very dry conditions during summer months the pit or trench method of conserving silage is to be recommended. Success in the case of the stock is dependent on a considerable proportion of the green material being clover. This is not possible in the drier areas, where the crop to be ensiled is usually a cereal.

The following notes regarding the making of silage by the trench method may be useful.

Choosing the Site for "Trench."—The site chosen should be elevated and well-drained, and as near the feeding troughs as practicable. A clay soil is preferable to a loamy one, but sandy soils should be avoided. In a sandy soil the seepage of water into the trench from the surrounding country would be considerable, any may act detrimentally on the silage. Should the drainage of the site not be good, a drain two feet deep should be dug round the trench after its completion, which will carry away surface water, and also the water which will flow from off the trench top itself, as when full of silage and covered with earth, the finished trench has the appearance of a mound

Excavating the Trench.—Having chosen the site, the surface dimensions of the trench should be marked out by four corner pegs. The dimensions of the bottom of the trench should also be marked out, so that the slope at each end may be properly estimated. The area pegged out is now ploughed with a suitable plough, the single-furrow mould board being usually found the most convenient. The earth as it is ploughed may be scooped out with the ordinary dam-sinking scoop. The excavated earth should be placed on the sides of the trench, as it is necessary to leave the ends open for convenience in filling. A slope of one in three should be left at either end so that the horses can get in and out when excavating and so that in filling, the carts can be driven through the trench, which will assist in packing the material ensiled.

The sides of the trench should be kept as near vertical as possible, even if a little spade work is necessary. Having the sides vertical will minimise wastage, as the material can settle uniformly. When scooping out the trench it is advisable to scoop a little hollow at the end which it is intended to open first. This is to enable any drainage water that may get into the silo after it is opened, to collect in this hollow, and so not penetrate into the silage. (See diagram.)



From page 349, Vol. 1, September, 1924.

Size of the Trench.—It is not advisable to make a smaller trench than one to hold fifty tons of silage. A convenient size is one to hold eighty tons, and such a trench would require twenty acres of an oat and pea crop to supply the necessary material, taking an average yield of hay as one ton per acre.

The following table will give the dimensions of trenches to hold 80, 72, 64, and 56 tons of silage:—

	80 tons. feet.	72 tons. feet.	64 tons. feet.	56 tons. feet.
Surface length	60	60	60	60
Breadth	20	18	16	14
Depth at centre of trench	7	7	7	7

In each case a slope of 1 in 3 is allowed at either end.

Crops to Grow.—Maize, in districts where it can be grown, is undoubtedly the most economical crop to grow for silage, because of the large yields obtained Crops of maize not infrequently yield as high as 25 tons per acre of green material When maize is grown for silage it should be cut when the cob is well formed and the grain is in the doughy stage. It will be found that at this stage the lower leaves are turning brown. Where maize can be grown, however, it is often possible to grow permanent pasture, and silage in such districts is to be looked upon as a wise insurance against a failure of this pasture, and of summer crops. In the greater portion of the State, where silage is most necessary, it is not practicable to grow maize, and resource must be had to the winter-grown cereal crops.

Cereal crops should be cut a little earlier than is usually done for hay, that is, when the grain is in the milk stage, and the straw just starting to change colour at its base.

In some portions of the State the spring growth of natural grasses and wild oats is considerable, and such material can be made into silage, and is best cut when the majority of the plants are in flower. If the grasses have harsh and fibrous stems at this stage, they should be cut before flowering, if necessary.

Filling the Trench.—The material to be put into the trench is usually cut with a binder, though a mower may be used. If the binder is used, and the material tied in sheaves, it is necessary to cut the bands before putting the material in the silo. This enables the material to be more firmly packed, and also facilitates the emptying of the silo. The twine, in itself, is undesirable, as unless well softened by the fermentation of the silage, may possibly cause an obstruction in the alimentary canals of animals fed on the silage. When filling, the carts may be driven into the trench before emptying; the trampling of the horses and the weight of the cart will assist to pack the material, an important point, as the making of good silage depends on the thorough exclusion of air, which can only be obtained by firm packing.

When cutting the crop it is advisable to cut only as much crop as will be loaded into the silo that day, as remaining some hours in the open will cause a lot of the moisture to be lost from the material.

The trench should be filled until about three feet above the level of the surrounding ground, making the centre slope off towards the sides of the trench. It may be necessary to top up the trench several times, as the sinkage is considerable, and may allow the surface of the filled trench to be below ground level, which is undesirable. When the filling of the trench is completed, earth is scooped back on the material, until a layer of earth of about 18 inches thick covers the whole area of the trench. If thought desirable, the material may be covered with chaff bags before scooping on the earth, though it is doubtful if the little material saved is worth the sacks used to save it. The green material, under the considerable pressure of the earth, will sink some 18 inches to two feet, and in the process of sinking cracks may appear in the covering of earth. If any such cracks do appear they should be filled in immediately or wastage may occur at these points, due to

the admission of air. With a trench such as has been described there will be very little waste, and if not required, the silage will keep almost indefinitely.

On farms, however, where it is considered desirable to conserve fodder as silage, and neither of the above methods is applicable, then resort must be had to the stack.

Method.—The building of stack silos should only be contemplated in order to preserve fodder, which would otherwise be difficult to handle economically.

The early top-dressing of pastures is now almost universally practised throughout the Dairy Belt, and has resulted in a plethora of green fodder in the months of September, October, and November. It is probable that this flush season will be considerably increased through the judicious use of nitrogenous fertilisers for top-dressing, and experiments will be carried out in this connection during the coming season.

Once the growth of a pasture has become rank, then the feeding value is decreasing, and the fodder should be immediately consumed by stock, or treated in some other way, so that a fresh, young and more nutritious growth may take place.

Should the weather permit, which generally will not be the case before late in spring, meadow hay is recommended as the most economical method of conserving this nutritious fodder, as with well-made hay there is little if any loss in nutriment.

It already has been found necessary in certain districts, however, to cut this rank growth early in spring, while rainy conditions still prevail, and it is in such cases that the stack silo is recommended as a method of saving a large proportion of this fodder when in its most nutritious state. This silage, too, is a further provision for ensuring a supply of green material for food in the summer months.

The following points are necessary to ensure success with the stack silo:—

1. The material to be ensiled should be quite green and succulent. A number of silos were noted in which the proportion of waste was over 30 per cent., due to the material being too dry. This admits an excessive amount of air, causing moulds to develop and allows too much fermentation. Such material should be made into meadow hay.

2. A considerable percentage of clovers is desirable, the best quality silage being noted in those stacks where the material was almost entirely subterranean clover. Crops such as oats, wheat, maize, and sorghums are not recommended for stack silage, owing to the difficulty of pressing sufficiently to exclude air.

3. The stack should be square, and should contain not less than 20 tons of silage. The square stack has less area exposed in proportion to volume than the oblong one. The minimum base for a stack should be 12 feet by 12 feet.

The following table shows the dimensions of the base of stacks of varying capacities:—

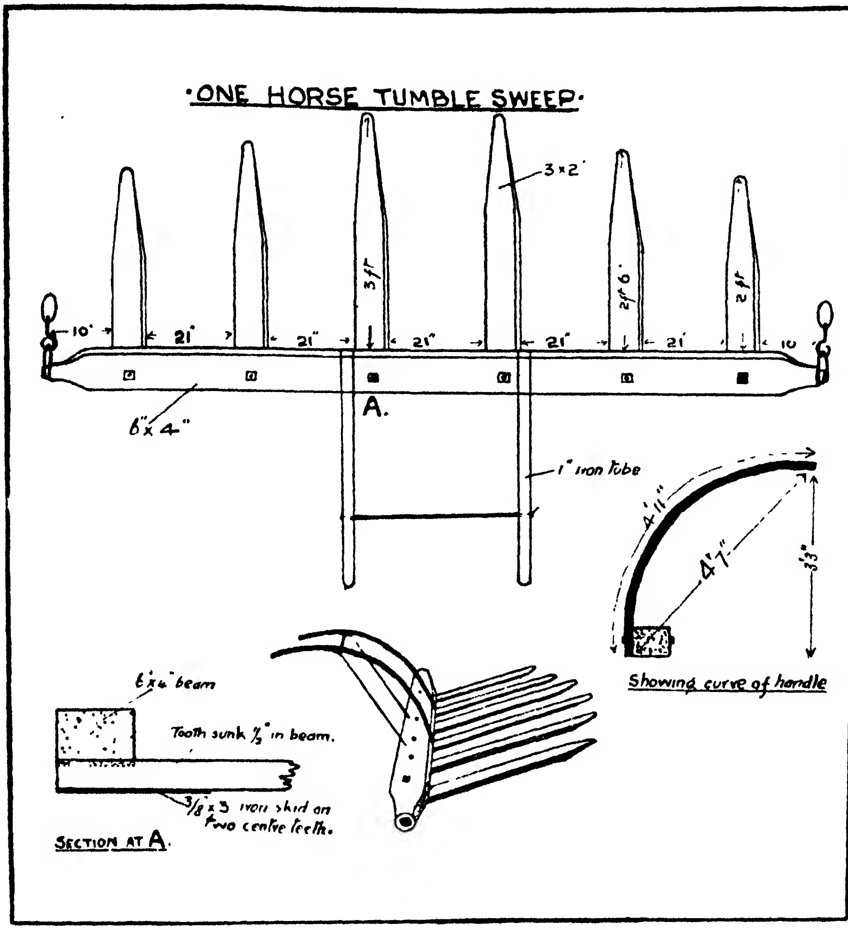
	Round Diameter Feet.
20 tons	12
30 tons	14
40 tons	16
50 tons	18

4. Grass should be cut for silage before seed-heads form, as the percentage of fibre increases very rapidly with maturity, leading to waste during fermentation owing to access of air.

5. Clover should be cut while forming seed, and before wilting commences.

6. Almost the only expense in the making of stack silage is that of handling the crop, which, without labour-saving devices, may be unnecessarily high.

The heavy work of loading green material on to drays or wagons may be considerably lightened by the use of the "Tumble Sweep," illustrated below:—



Plan of details of One-horse Tumble Sweep

7. The stack may be completed immediately, but it will usually be found preferable to spread the building over several days. This is no detriment and allows a certain amount of sinking to take place. It should be made as high as possible, 12 feet being a convenient height before settling takes place. Care must be used to ensure the stack is on a level base and that building has been even, so as to allow for regular sinking, otherwise the stack will slip, open, and the material be ruined.

Cutting, carting and stacking may be continued irrespective of the weather, whether rainy or fine. In order to prevent slipping, posts may be placed at each corner, more than four being undesirable, as likely to prevent even settlement.

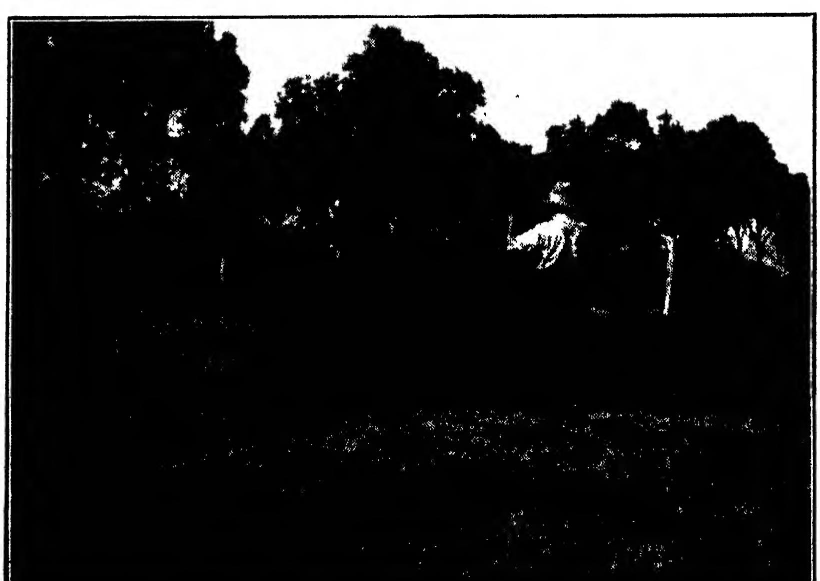
8. As each day's portion of the stack is built, the sides should be scraped free from loose material, which otherwise would be wasted.

9. The stack should be finished off flat at the top, so that posts or planks may be placed thereon, and sacks of dirt or loose earth thrown on to assist in excluding the air by pressure—9 inches of earth has been found quite sufficient, or a layer of sugar-bags of earth placed on posts.

Subsidence is considerable, a 12ft. stack commonly sinking to 5 or 6 feet within six weeks.

10. An examination of a number of stacks has shown that, where the average depth to which air has intruded on three sides may be not more than 8 inches, on the side of the prevailing winds during the hot months the material has been destroyed to a depth of 18 inches, through infiltration of air and the drying effect of

One-horse Tumble Sweep being operated on farm of Messrs. Bayley Bros., Denmark.



Showing tumbling action of sweep, minimising handling the material.

the wind. It is recommended that this side be protected either by sheet iron or by bushes built against the stack, so as to break the force of the wind.

11. Stacks should be opened from the top, a full layer not less than 1½ inches thick being removed each day. Opening from the sides exposes a fresh surface unduly, causing waste.

Feeding Silage H. C Barnsby, Clovelly Farm, Pemberton.

12. Good clover silage does not need the addition of a concentrate when fed to cows of average production. When silage is made from grass or cereal crops, however, disappointing results are obtained where fed alone to milk cows, ewes, or lambs. The addition of a concentrate such as oats, bran, linseed meal, peas, etc., is then necessary to increase the protein content, otherwise supplied by the leguminous crop.

A well-built 40-ton silage stack. Dr. A. G Abbott, Eastbrook. Bags of earth held in position by wire threaded through end; centre filled with earth.

THE COST OF FEEDING PURE-BRED COWS UNDER THE AUSTRALIAN OFFICIAL HERD-RECORDING SCHEME, WESTERN AUSTRALIA, 1931-32.

G. K. BARON-HAY, Superintendent of Dairying,
L. C. SNOOK and H. G. ELLIOTT.

Since 1924 an accurate record has been available regarding the costs of feeding the pure-bred cows under official test. Monthly visits to the herds under test are made by the recording official, who records the rations being fed, together with the butter fat and milk record of cows in the various herds.

The following tables give the cost of feeding, together with other information relating to production, of the herds under test during 1931-32.

The various foodstuffs were valued at the average rate ruling during the twelve months ended 30th June, 1932, as follows:—

	£	s.	d.	
Chaff—Oaten or Wheaten	4	0	0	per ton.
Loose Hay	2	0	0	,,
Clover Hay	2	15	0	,,
Silage	0	7	0	,,
Oats (Crushed)	0	2	0	per bushel.
Wheat	0	3	4	,,
Bran	5	10	0	per ton.
Pollard	5	17	6	,,
Linseed Meal	12	10	0	,,
Lucerne Hay	6	0	0	,,
Green Lucerne	1	10	0	,,
Oil Cake	0	12	0	per cwt.
Meat Meal	0	7	9	per 50 lbs.
Grains	0	0	6	for 75 lbs.
Potatoes	2	15	0	per ton.
Maize ... } Grazed ... ... / Sudan Grass }	0	2	6	per head. per week.
Barley ... } Chaffed	0	6	0	Per ton.
Pasture	0	1	6	per head per week.

The results obtained during the period under review show that the low costs arrived at during the previous year, 1930-31, have been maintained by breeders. This is no doubt partly due to the increased provision of home-grown fodders, the percentage of farmers providing silage being 62 per cent. this year, as against 37 per cent. last year (1930-31).

TABLE 1.

COST OF FEED PER GALLON OF MILK AND PER LB. OF BUTTER FAT.

Year.	Average Cost of Feed per Cow for 9 months.	Cost of Feed to produce 1 gallon Milk.	Cost of Feed to produce 1 lb. Fat.
Average—	£ s. d.	d.	d.
1924–30	14 3 8	5·54	11·42
1929–30	14 10 3	5·10	12·74
1930–31	9 14 7	3·63	7·74
1931–32	10 18 3	3·76	8·21

During the period under review the price of butter-fat has fallen slightly, the average price for 1930-31 being 1s. 3d. per lb.; while for 1931-32 the average price has been 1s. 2.37d. per lb.

It is only by reducing the costs of feeding that the low prices received for butter-fat can be combated, as breeding higher-producing stock needs several years to achieve success. The increase in the number of herds being fed silage is remarkable, and is further evidence, if any be required, of the value of this fodder for the economical production of milk and butter-fat.

TABLE 2.

VALUE OF HOME-GROWN FODDERS.

	A. With Silage (10 herds).	B. Without Silage (6 herds).	Per cent. in favour of herds having Silage.
			%
Per 1lb. Butter Fat ...	7·87	9·62	22·23
Per 1 gallon of Milk ...	3·82	4·18	9·9

One of the outstanding features of the results during 1931-32 has been the excellent performances put up by cows in herds in the drier areas of the State; but on averaging the costs of feeding in these areas, the cost is high in comparison with herds in the dairy districts proper, as is shown in the following Table 3.

TABLE 3.

COST OF PRODUCTION IN LIGHT RAINFALL AREAS COMPARED WITH SOUTH-WEST CONDITIONS.

	Production.		Cost of Feed for—	
	Milk.	Fat.	1 gallon Milk.	1lb. Butter Fat.
	gals.	lbs.		
9 Herds—Dry Areas ..	723·8	324·54	4·21	8·97
7 Herds—South-West ..	595·7	278·55	3·80	7·33

As in previous years, the three breeds under test have been compared as regards cost of feeding and average yields (see Table 4).

TABLE 4.

	Breed.	Average Yield of Butter Fat.	Average Yield of Milk.	Average Cost of Feed.
		lbs.	gals.	£ s. d.
1	Australian Illawarra Shorthorn (6 herds)	333·00	822·55	11 15 0
2	Guernsey (3 herds) ...	314·49	606·7	11 13 3
3	Jersey (7 herds) ...	286·61	545·8	11 0 4

These figures represent the relative position of cows of these breeds for one year only, and should not be used as an argument against or in favour of any one breed.

The following is a list of the tables inserted, with the information embodied:—

Table 5. Herds in order of merit as producers of butter-fat.

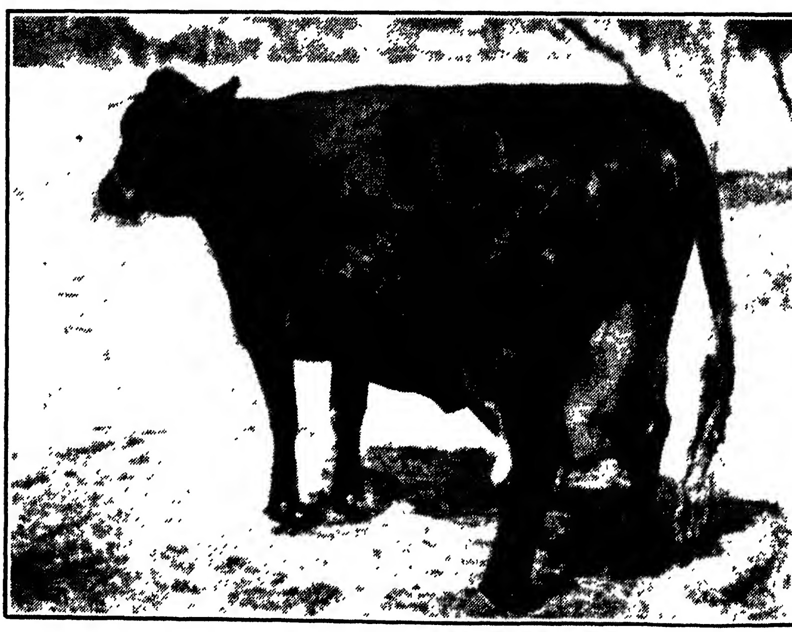
Table 6. Herds in order of merit as producers of milk.

Table 7. Herds in order of merit of cost of producing 1 lb. butter-fat.

Table 8. Herds in order of merit of cost of producing 1 gallon of milk.

Table 9. Herd averages for 9-year period.

Table 10. Summary of results, 1931-32.



Gold of East View (10940), owned by W. G. Burges, "Tipperary," York.
Top cow in Sen. 4yr.-old class. Standard 330 lbs. Butter Fat.
Production:—12,675 lbs. Milk; Av. Test 4.01%; 508·73 lbs. Fat.

TABLE 5.—HERDS IN ORDER OF MERIT AS PRODUCERS OF BUTTER FAT.

Herd.	Breed.	Average Production of Butter Fat per Cow for 9 months	Average Production of Skim Milk per Cow for 9 months	Value of Butter Fat at 1s. 2d. per lb.	Value of Skim Milk at 1d. per gallon	Gross Returns for Fat and Skim Milk	Cost of Feed per Cow for 9 months.	Profit per Cow by Sale of Butter Fat.	Cost of Feed to produce 100lbs. of Butter Fat.	Cost of Feed to produce 1 lb. of Butter Fat.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
A	Guernsey	386·91	647·4	22 11 5	2 13 11	25 5 4	14 4 3	11 1 1	3 13 6	8·82
B	Australian Illawarra Shorthorn	377·01	812·3	21 19 10	3 7 8	25 7 6	9 4 8	16 2 10	2 9 0	5·88
C	do. do. do.	352·93	809·2	20 11 9	3 7 5	23 19 2	12 19 6	10 19 8	3 14 11	8·99
D	Jersey	337·95	527·4	19 14 3	2 3 11	21 18 2	12 17 4	9 0 10	3 13 4	9·13
E	Australian Illawarra Shorthorn	335·52	767·0	19 11 5	3 3 11	22 15 4	12 12 7	10 2 9	3 15 3	9·03
F	Jersey	331·29	599·1	19 6 6	2 19 11	22 6 5	7 17 8	14 8 9	2 7 7	5·71
G	Australian Illawarra Shorthorn	314·80	696·6	18 7 3	2 18 0	21 5 3	11 9 8	9 15 7	3 12 11	8·75
H	do. do. do.	312·39	737·5	18 4 5	3 1 5	21 5 10	8 15 8	12 10 2	2 16 2	6·74
I	do. do. do.	305·37	619·2	17 16 3	2 11 7	20 7 10	15 8 0	4 19 10	5 0 10	12·10
J	Jersey	303·31	550·8	17 13 10	2 5 11	19 19 9	10 11 5	9 8 4	3 9 8	9·36
K	do.	303·12	494·7	17 13 7	2 1 2	19 14 9	13 7 5	6 7 4	4 8 2	10·58
L	Guernsey	286·65	504·6	16 14 9	2 2 0	18 16 9	12 17 9	5 19 0	4 9 10	10·78
M	Jersey	286·56	520·4	16 14 4	2 3 4	18 17 8	12 13 9	6 3 11	4 4 6	10·68
N	Guernsey	269·91	485·2	15 14 8	2 0 5	17 15 1	7 17 9	9 17 4	2 18 5	7·01
O	Jersey	224·82	422·4	13 2 3	1 15 2	14 17 5	9 7 2	5 10 3	4 3 3	9·99
P	do.	220·23	323·7	12 16 11	1 7 0	14 3 11	10 18 0	3 5 11	4 19 0	11·88
	Average	318·96	626·6	19 2 1	2 12 2	21 14 3	10 18 3	10 16 0	3 8 5	8·21

East View Lucky Pretty Maid 3rd (8481) owned by A. E. Grant, "Yanget," Geraldton.

Top production cow in Official Herd-Testing Scheme, 1931-32.

Production:—13,921 lbs. Milk; Av. Test 4·0%; 557·63 lbs. Butter Fat in 273 days.

TABLE 6.

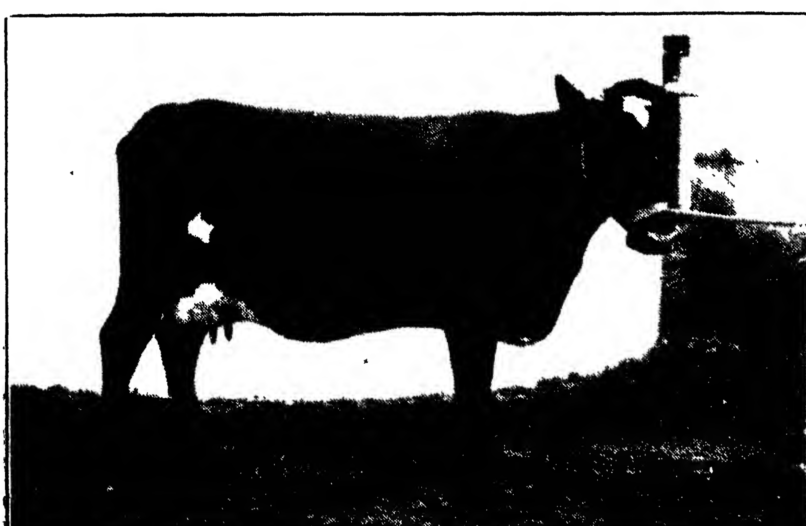
HERDS IN ORDER OF MERIT AS PRODUCERS OF MILK.

Herd.	Average Yield of Milk per Cow for 9 months.	Value of Milk at 10d. per gallon.	Cost of Feed per Cow for 9 months.	Profit on Sale of Whole Milk.	Cost of feed to produce 1 gallon of Milk.	Breed.
	gals.	£ s. d.	£ s. d.	£ s. d.	d.	
B ...	902·5	37 12 1	9 4 8	28 7 5	2·45	Australian Illawarra Shorthorn.
C ..	899·1	37 9 3	12 19 6	24 9 9	3·46	do. do.
E ...	852·2	35 10 2	12 12 7	22 17 7	3·55	do. do.
H ...	819·5	34 2 11	8 15 8	25 7 3	2·57	do. do.
G ...	774·0	32 5 0	11 9 8	20 15 4	3·56	do. do.
A ...	719·4	29 19 6	14 4 3	15 15 3	3·07	Guernsey.
I ...	688·0	28 13 4	15 8 0	13 5 4	5·73	Australian Illawarra Shorthorn.
F ...	665·6	27 14 8	7 17 8	19 17 0	2·84	Jersey.
J ...	612·0	26 0 0	10 11 5	15 5 4	5·37	do.
D ...	586·0	24 8 4	12 17 4	11 11 0	5·27	do.
M ...	578·3	24 1 11	12 13 9	11 8 2	5·27	do.
L ...	560·7	23 7 3	12 17 9	10 9 6	5·52	Guernsey.
K ...	549·7	22 18 1	13 7 5	9 10 8	5·83	Jersey.
N ...	539·1	22 9 3	7 17 9	14 11 6	3·07	Guernsey.
O ...	469·4	19 11 2	9 7 2	10 4 0	4·78	Jersey.
P ...	359·7	14 19 9	10 18 0	4 1 9	7·27	do.
Average	696·2	29 0 2	10 18 3	18 1 11	3·76	

TABLE 7.

HERDS IN ORDER OF MERIT SHOWING COST OF FEED PER LB. OF BUTTER FAT PRODUCED.

Herd.	Cost of Feed per lb. of Fat.	Under Average.	Over Average.	Breed.
	d.	d.	d.	
F	5·71	2·5	...	Jersey.
B	5·88	2·33	...	Australian Illawarra Shorthorn.
H	6·74	1·47	...	do. do.
N	7·01	1·20	...	Guernsey.
J	8·36	...	0·15	Jersey.
G	8·75	...	0·54	Australian Illawarra Shorthorn.
A	8·82	...	0·61	
C	8·99	...	0·78	
E	9·03	...	0·82	do. do.
D	9·13	...	0·92	do. do.
O	9·99	...	1·78	Jersey.
K	10·58	...	2·37	do.
M	10·62	...	2·41	do.
L	10·78	...	2·57	Guernsey.
P	11·88	...	3·67	Jersey.
I	12·10	...	3·89	Australian Illawarra Shorthorn.
Average ...	8·21	...	...	



Kitty 8th of Kurrawong, owned by W. G. Burges, "Tipperary," York.
Top cow in the Jun. 4yr.-old class. Standard 310 lbs. Butter Fat.
Production:—9,114 lbs. Milk; Av. Test 4.7%; 423.00 lbs. Fat.

Victress of Toora, owned by W. G. Burges, "Tipperary," York.
Highest producing cow in Jun. 3yr.-old class. Standard 270 lbs. Fat.
Production:—9,642 lbs. Milk; Av. Test 4.65%; 448 19 lbs. Butter Fat.

TABLE 8.

HERDS IN ORDER OF MERIT, SHOWING COST OF FEED TO PRODUCE ONE GALLON OF MILK.

Herd.	Cost of Food to produce 1 gallon Milk.	Below Average Cost.	Over Average Cost.	Breed.
	d.	d.	d.	
B	2·45	1·31	...	Australian Illawarra Shorthorn.
H	2·57	1·19	...	do. do.
F	2 84	0·92	...	Jersey
A	3·07	0·69	...	Guernsey.
C	3·46	0·30	...	Australian Illawarra Shorthorn.
N	3·53	0·23	...	Guernsey.
E	3·55	0·21	...	Australian Illawarra Shorthorn.
G	3·56	0·20	...	do. do.
J	4·11	...	0·35	Jersey.
O	4·78	...	1·02	do.
D	5·27	...	1·51	do.
M	5·27	...	1·51	do.
I	5·37	...	1·61	Australian Illawarra Shorthorn.
L	5·51	...	1·75	Guernsey.
K	5·83	...	2·07	Jersey.
P	7·27	...	3·51	do.
Average ...	3·76	...	...	

TABLE 9

HERD AVERAGES FOR 9 YEARS—1924 1932.

Year.	Milk.	Average Fat per Cow for period of 9 months.	Average Skim Milk per Cow for period.	Value of Fat for period.	Value of Skim Milk for period at 2d. per gallon.	Average Value of Fats and Skim Milk for period.	Cost of Feed per Cow for period.	Net profit per Cow for period through sale of Fat	Value of Whole Milk at 1s. 3d per gallon allowing for rearing calf.	Net profit per Cow through sale of Fresh Milk at 1s. 3d. per gallon.	Average Cost to produce 1 lb. Fat.	Average Cost to produce 1 gallon of Milk.
	gals.	lbs	gals.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d		
1924 ..	630	319·50	362	At 1s. 7d. per lb 25 19 2	3 0 4	28 19 6	10 4 10	18 4 8	32 1 3	21 16 5	7 70	4·09
1925 ...	652	308 54	407	At 1s 5½d per lb 22 10 0	3 7 10	25 17 10	14 13 2	11 4 8	30 10 5	15 9 5	10 77	6·15
1926 ..	624	312 01	393	At 1s 7d per lb. 24 14 0	3 5 6	27 19 6	14 14 7	13 4 11	32 5 5	17 10 10	11 15	5·66
1927 ..	602	290 72	332	At 1s. 7d per lb 23 0 4	3 0 4	26 0 8	14 10 5	12 6 8	31 10 6	17 0 1	12 00	5·76
1928 ..	592	280 56	353	At 1s. 7½d per lb 22 15 9	2 18 10	25 14 7	15 11 4	10 3 3	30 19 0	15 7 8	13 34	6·34
1929 ...	620	295 10	386	At 1s 8d. per lb 24 11 10	3 4 4	27 16 2	15 1 0	12 15 2	33 6 9	18 5 9	12·24	5·74
1930 ...	633	294 98	369	At 1s 7½d per lb. 23 19 6	3 5 4	27 4 10	14 10 3	12 14 7	30 3 3	15 13 0	12·74	5·10
1931 ...	643	301 60	399	At 1s. 4d per lb 20 2 2	At 1d per gal 1 13 3	21 15 5	9 14 7	12 0 10	At 1s. 1d. per gal 25 10 1	At 1s. 1d. per gal. 15 15 6	7 74	3·63
1932 ..	633	318 93	479	At 1s 2d. per lb. 19 2 1	At 1d per gal 1 19 11	21 2 0	10 18 3	10 3 9	At 10d. per gal 25 0 0	At 10d per gal 14 1 9	8·21	3·76
Average, 9 years	630 5	302 42	378 8	23 1 8	2 17 3½	25 18 11½	13 6 6	12 12 5½	30 2 11	16 16 5	10 57	5·07

TABLE 10.

SUMMARY OF RESULTS, 1931-32.

PRODUCTION PER COW FOR 9 MONTHS.

1.—696 gallons of Milk per Cow.
2.—318·9 lbs. of Butter Fat per Cow.

	£	s.	d.
1.—Value of Butter Fat at 1s. 2d. per lb.	19	2	1
Value of Skim Milk at 1d. per gallon	1	19	11
Total return by sale of Butter Fat	21	2	0
Cost of Feed for Period	10	18	3
Gross Profit	10	3	9
2.—Value of Whole Milk at 10d. per gallon	25	0	0
Cost of Feed for Period	10	18	3
Gross Profit	14	1	9

Cost of Feed to produce 1 gallon of Milk ... ... 3·76d.
Cost of Feed to produce 1lb. of Butter Fat ... ... 8·21d.

Nooka Wild Rose (28191), owned and bred by S. P. Herbert, "Nooka," Nungarin.

Top cow in Sen. 2yr.-old class. Standard 250 lbs. Butter Fat.
Production:—6,619 lbs. Milk; Av. Test 5.43%; 358.55 lbs. Fat.

"THE JOURNAL OF AGRICULTURE"

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Esperance Wheat Lands.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF JUNE, JULY, AND AUGUST, 1932.

	June.					July.				August.				
	1.	8.	15.	22.	29.	6.	13.	20.	27.	3.	10.	17.	24.	31.
Sheep	8,571	8,149	7,888	10,640	11,540	10,837	11,351	10,281	11,935	11,015	10,843	13,884	12,095	10,184
Cattle	466	615	645	449	382	609	575	549	541	521	510	487	497	492
Pigs ...	1,453	1,560	1,608	1,272	1,736	1,589	1,356	1,554	2,046	1,910	1,174	1,531	1,909	1,801

COMPARATIVE VALUES PER POUND.

Mutton	3¼d.	3¼d.	4¼d.	4¼d.	3¾d.	3¾d.	4¼d.	5d.	5d.	4¾d.	4¾d.	4¾d.	4¾d.	4¾d.
Beef ...	5¾d.	5¾d.	5d.	4¼d.	4d.	4d.	4d.	4¾d.	4½d.	4½d.	4½d.	4½d.	5½d.	5½d.
Pork ...	6½d.	6d.	5¾d.	5¾d.	5¾d.	5¾d.	5¾d.	5¾d.	5¾d.	5¾d.	5½d.	5½d.	5½d.	4½d.
Bacon	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5d.	5¼d.	5¼d.

Merino Rams.

MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding chaff offered at auction in the Perth Railway Yards for the period June to August (inclusive). In all cases the prices quoted are for f.a.q. to prime wheaten chaff, packed in new bags:—

	Quantity.	Maximum. £ s. d.	Minimum. £ s. d.
June, 1932	830 tons	5 0 0	4 10 0
July, 1932	770 tons	4 15 0	4 5 0
August, 1932	630 tons	4 7 6	3 17 6

During June fair supplies of f.a.q. to prime wheaten chaff arrived for auction, and at the beginning of the month f.a.q. to prime was selling at £4 10s. 0d.; f.a.q. at from £4 2s. 6d. to £4 5s. 0d. per ton. Towards the end of the month the market firmed to £5, and f.a.q. realised £4 10s. 0d. to £4 12s. 6d. per ton. During the early part of July the market remained at around £4 15s. 0d., but towards the end of the month values eased to £4 5s. 0d. F.a.q. changed hands at from £3 15s. 0d. to £4 2s. 6d. per ton. Notwithstanding the shorter supplies of chaff that were available for auction during August, the market declined still further. F.a.q. to prime sold at from £3 17s. 6d. to £4 7s. 6d.; f.a.q. from £3 15s. 0d. to £3 17s. 6d. per ton.

Oaten Chaff.—During the same months of June, July, and August prime quality was scarce, and some was in demand at from £4 7s. 6d. to £4 12s. 6d.; f.a.q. from £4 2s. 6d. to £4 5s. 0d. per ton.

Oats.—Throughout the period under review the market remained steady, the closing quotations being as under:—

June, July, and August:

Good heavy feed Guyras and Mulgas	2s. 3d. to 2s. 5d. per bushel.
Good feeds	2s. 0d. to 2s. 2d. per bushel.
Light feeds	1s. 8d. to 1s. 9d. per bushel.

Wheat.—During June f.a.q. found buyers at from 3s. to 3s. 5½d. per bushel; second grade, from 2s. 10d. to 3s. In July f.a.q. realised from 3s. to 3s. 3d.; second grade, from 2s. 10d. to 3s. per bushel. We are pleased to report that during August the market firmed from 3s. 3d. to 3s. 5½d. per bushel; second grade changed hands at from 3s. to 3s. 2½d.

We have a good inquiry for all produce lines mentioned above, and farmers consigning to us for sale at auction can be assured of securing the highest market values, and prompt returns.

PRODUCERS' MARKETS CO-OPERATIVE, LIMITED.

QUARTERLY REPORT FOR THE THREE MONTHS ENDING 12TH SEPTEMBER, 1932.

Fruit.—Supplies throughout the quarter have been very steady. Apples, with the exception of two or three sales, have been selling at steady rates; at the end of the quarter Granny Smiths touched 14s. for 2½in. and 10s. 6d. to 11s. 6d. for 2¾in.; other varieties, 9s. to 10s. 6d. Navel oranges in the first month sold at satisfactory rates and at the end of the period firmed, prime quality realising to 14s. 6d. per bushel case. Lemons throughout were dull, but with the advent of warmer weather prices should improve for this fruit. Tomatoes from the Geraldton district were forwarded during the second month under review, but the crops being planted too early the quality of the tomatoes was poor and low values resulted. Mandarins were well supplied, consisting mostly of small and sour fruit. Good lines realised high values. Cape gooseberries and passion fruit short, with values firm.

Vegetables.—Supplies throughout the quarter have been very steady, and a steady demand was maintained for good quality country potatoes. Values showed little change. Metropolitan new dug lines were also in request, but values steadily firmed all the time. Swedes were plentiful, and inferior lines dull. Choice lines of graded were in demand and values were well above the average. Pumpkin values were low at the commencement of the quarter, but special lines were in better demand later. Cabbage supplies were heavy during the early part of the quarter and values were low, but with the shortening of supplies of other lines of vegetables prices firmed considerably. Beans improved considerably after the first frost. Geraldton crops were light, and all good qualities sold well. Peas ex Geraldton were also in good demand, local supplies being very short. Cauliflowers were heavily supplied during June and early part of July, but from then until the middle of August values were firm. Top prices for the season being obtained during this period. Rhubarb values firmed sharply; about the middle of the quarter held firm. Celery plentiful, principally from the York district. The quality this year was splendid, but values were lower than generally realised for this crop. In the bunch section beetroot and turnips were plentiful and values easy. Carrots were steady throughout. Parsnips of good quality firm. Lettuce also in good demand at firm rates.

Eggs.—During the quarter under review supplies both from the metropolitan and suburban districts commenced to show a noticeable increase towards the middle of June, and this increase had the corresponding effect of causing values to ease. During July supplies were still further increased, with the result that export operations were commenced about the middle of the month. The quantities packed for export had the desired effect of relieving the local floor and keeping values stable. The prices offered by export agents for exportable eggs has been a blessing to the poultry farmer, and as long as these prices are offering present values on the local market will be maintained.

Poultry.—During the quarter under review supplies of poultry have been heavy, with all prime lines in demand, with values much higher than those ruling during the previous twelve months. At present turkey hens and gobblers are offering to a keen demand at satisfactory values.

METEOROLOGICAL INFORMATION.

JUNE.

Stations.	Temperature. Maximum. Mean.	Temperature. Maximum. Highest.	Temperature. Minimum. Mean.	Temperature. Minimum. Lowest.	Rainfall. For Month.	Rainfall. Average.
					inches.	inches.
Chapman State Farm	67·7	76·3	46·1	36·8	1·82	4·30
Geraldton	69·5	76·0	52·5	41·2	2·93	4·79
Walebing	63·2	71·0	41·2	29·0	3·06	4·03
Perth	65·3	73·0	48·8	38·4	6·47	7·03
Kalamunda	60·1	68·2	48·9	39·0	6·47	8·27
Bunbury	63·7	69·0	48·9	36·4	4·62	7·23
Bridgetown ..	61·7	69·0	41·8	33·0	7·84	5·88
Albany . ..	62·9	70·0	48·7	41·0	4·67	5·44
Merredin State Farm	62·7	75·2	41·6	30·2	0·69	1·91
Northam .. .	64·5	72·4	41·5	32·0	2·24	3·29
York .	63·6	72·0	40·7	30·0	2·16	3·34
Narrogin State Farm	60·1	70·0	42·1	30·0	2·54	3·68
Katanning	60·3	69·0	44·7	34·3	3·54	2·93
Cape Leeuwin	62·2	67·2	55·2	50·0	8·54	6·86

JULY.

Stations.	Temperature. Maximum. Mean.	Temperature. Maximum. Highest.	Temperature. Minimum. Mean.	Temperature. Minimum. Lowest.	Rainfall. For Month.	Rainfall. Average.
					inches.	inches.
Chapman State Farm	65·6	74·5	48·0	42·2	3·66	4·03
Geraldton	68·1	74·0	54·2	47·2	4·91	3·90
Walebing	62·3	78·6	43·8	37·7	4·96	3·77
Perth	63·4	68·3	49·9	42·0	9·72	6·72
Kalamunda	59·4	65·0	46·8	40·0	11·82	8·57
Bunbury	62·4	68·0	47·5	38·5	4·85	6·91
Bridgetown ..	60·0	68·0	40·1	30·2	6·73	5·78
Albany . ..	60·5	67·8	46·2	38·0	5·48	5·61
Merredin State Farm	60·4	68·9	43·0	36·0	2·31	1·88
Northam .. .	62·2	70·0	43·6	36·2	5·73	3·48
York .	61·8	67·5	43·1	34·0	4·70	3·43
Narrogin State Farm	58·4	63·4	40·7	34·0	5·45	4·20
Katanning	57·1	63·7	42·0	33·0	5·24	3·07
Cape Leeuwin	60·2	64·2	52·4	45·8	7·55	7·29

AUGUST.

Stations.	Temperature. Maximum. Mean.	Temperature. Maximum. Highest.	Temperature. Minimum. Mean.	Temperature. Minimum. Lowest.	Rainfall. For Month.	Rainfall. Average.
					inches.	inches.
Chapman State Farm	64·1	73·7	46·0	36·3	5·56	2·64
Geraldton	67·0	78·2	51·8	39·0	4·51	2·86
Walebing	64·5	75·0	41·2	32·0	6·45	3·06
Perth	61·4	77·4	47·3	40·5	6·13	5·73
Kalamunda	58·1	73·8	44·4	39·0	8·02	6·86
Bunbury	60·9	71·4	45·5	35·4	2·77	5·31
Bridgetown ..	59·3	72·0	39·7	31·0	5·44	5·09
Albany . ..	59·6	74·0	46·1	41·0	9·75	5·21
Merredin State Farm	59·1	74·3	39·9	31·5	2·83	1·45
Northam .. .	61·0	76·0	41·6	34·0	5·36	2·57
York .	60·2	75·0	40·7	32·0	4·45	2·81
Narrogin State Farm	56·1	69·3	39·7	28·8	3·58	3·16
Katanning	56·8	69·0	42·5	32·1	2·47	2·47
Cape Leeuwin	58·9	69·8	51·0	47·0	5·92	5·27

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE

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SOMETHING FOR NOTHING.

(Editor.)

There is an old Scotch saying that enjoins you to "aye be speirin'," or, in her words, always be inquiring. Thus shall we improve our knowledge and aderstanding.

On the other hand, some cynic once said: "Advice for nothing is worth it." out it is much easier to be a cynic than a wise man, and one must not confuse wit with wisdom.

We have quite a lot of time for the Scots but we don't go much on cynics.

What we are leading up to is this: Some men on the land meet with failures nd know not why. Some others are inquisitive, and want to know; these wisely nd their inquiries to the Department of Agriculture, which is at all times ready nd willing to supply advice free.

It is the function of the Department to help the farmer to solve his problems. ery often the problem to the farmer is not a problem at all to the Department. his is proved by numerous Bulletins that are issued on a variety of subjects, and an be had free by all persons in the State who are following farming and kindred ursuits.

In an article appearing in this issue the Director of Agriculture (Mr. G. L. Sutton) contributes some interesting data on the part played by science in the welfare of agriculture in Western Australia. Read this; it will enlighten you.

All this information acquired is disseminated quarterly in the pages of this Journal. Bulletins and leaflets are extracted in handy form for posting, therefore, if you are in a difficulty, write and ask.

There are Bulletins on the pests that confound the farmer's labour, and remedies to confound his pestilential enemies; there is advice about crops, and the important industries of the man on the land; and articles dealing with the latest scientific practice for increasing yields and improving products; the best methods of packing and marketing. Officers of the department are pleased to identify specimens of insects and plants; to diagnose diseases of plants and animals and give directions for treatment.

If you are engaged in the agricultural, pastoral, or horticultural industries, the Department is for you. Use it. Don't waste time planning out your own remedies, but write and explain your troubles to the Department, and let it "put you wise."

SOME CONTRIBUTIONS OF SCIENCE TO THE WELFARE OF AGRICULTURE IN W.A.

Being a Paper read by the Director of Agriculture (Geo. L. Sutton) before the Royal Society in Western Australia.

The most tangible evidence in this State of the aid which agriculture has received from Science is the establishment of six huge plants, one each at North Fremantle, Bayswater, Bassendean, and Geraldton and two at Bunbury (with one operating at each centre) for the manufacture of Superphosphate. That their product is an essential factor to success in all branches of agriculture is reflected in their out-turn in a normal season of some 250,000 tons per annum.

Superphosphate is now so universally accepted as one of the needs of agricultural life, that its association with Science is overlooked by the average man. Few people associate the huge commercial enterprise of superphosphate-making with the initial laboratory experiments of chemists who, in the early years of the 19th century, treated bones with sulphuric acid, or with the work of a Dublin physician, Murray, who conceived the idea of using mineral phosphates (Coprolites) to replace the more expensive bones, and who, simultaneously, with Lawes, in 1842, patented the process which proved to be the forerunner of the present one by which our entire supplies of superphosphate from phosphatic rock are manufactured. Incidentally, it may be stated that it was Murray* who first suggested the use of the word "superphosphate" and adopted it in the description of his patent.

Present-day superphosphate is a vast improvement on the original product, and because of its perfect physical condition and its cheapness, it meets the requirements of the agriculturist to a remarkable extent. Its excellence and uniformity are a triumph for the chemist, and a tribute to the administrative and technical officers associated with its manufacture.

A contribution to our agricultural well-being, from another branch of Science—Zoology—was the discovery of the cause and remedy, of what is known in this State as Toxic paralysis or Botulism. This disease is so serious that, from the reports which have reached the Department of Agriculture, the Chief Veterinary Officer (Mr. A. L. McKenzie-Clark) considers that no single disease has a greater death roll or makes a greater toll upon the productivity of our stock, than does this one.

It is now known that this disease is indirectly due to a deficiency of phosphorus in the food. This discovery was made in South Africa, as the result of an investigation into the cause and prevention of "Lamziekte." Some of us had the privilege of hearing the masterly review of the details and results of this investigation, delivered before this society on September 5, 1928, by Sir Arnold Thieler, the senior investigator. He disclosed that the cause of the trouble had been determined and the remedy made available, only after seven years of patient research; and that although the work had been commenced some 20 years previously, and the major problem had now been solved, study was being continued along some of the by-paths which had been opened up.

* "Superphosphate," Vol. V., 1932, pp. 75-86.

The results, following the solution of this problem, provide an excellent illustration of the fact that the benefits of scientific discoveries are not confined by national geographical boundaries. The solution of the problem was destined to have an enormous beneficial effect upon the health and productivity of the flocks and herds of Australia, situated some 4,500 miles away from the site of the original investigation.

Here too, history has repeated itself. As in the case of phosphatic fertilisers bones were first used to remedy phosphatic deficiency in soils, and were later replaced by mineral phosphates in the manufacture of phosphatic fertilisers, so bonemeal was first used as the remedial agent for Lamziekte or Botulism, but is now being replaced with great advantage by the mineral compound dicalcic phosphate, which is not only cheaper than bonemeal but has about twice its assimilability—thus constituting another contribution by Chemistry to Agriculture.

Coming now to a successful contribution made by bacteriology, in which the Royal Society has a special interest, for our foundation President—Professor Dakin—made a preliminary investigation of it in 1918-19. It remained, however, for a member of our Council—Dr. Bennetts—to find the cause of the Braxy-like Disease in 1930, and finally to prove his conclusion and suggest the remedy in 1931. In this case the very tangled skein of a difficult problem was unravelled step by step, as the result of painstaking and almost ceaseless effort. The final stage was expedited by another worker who found that milk was suitable, and water unsuitable, as a carrier for the organism which the experimental animals were required to ingest.

The discovery of the cause of the Braxy-like Disease—Infectious Entero Toxæmia—is leading to the solution of another disease of almost world-wide distribution, the pulpy Kidney Disease in lambs.

Dr. Bennetts has made another very valuable contribution to our agricultural development by his studies of the internal parasites of stock, as the result of which he has compiled a census of them.

With the innate caution of scientists, Mr. Filmer and his collaborator Dr. Underwood are not yet prepared to announce the solution of the Denmark Wasting Disease, but the first positive results have been obtained and it would appear that these investigators are on the threshold of success.

The now recognised stable cultivation practice of the Wheat Belt has been evolved as the result of the systematic experiments carried out on the State Experiment Farms during the past 17 years. As the result of these experiments in the realms of Physics, Chemistry and Botany it may be said that the productivity of a new province—the Eastern portion of the Wheat Belt—has been ensured and stabilised. The up-to-date wheat farmer now carries out his routine work with system and confidence both of which were entirely absent a decade ago. In this connection it is interesting to point out that, of the varieties of wheat which were in general cultivation in this State two decades ago, only two, viz., "Gluyas Early" and "Yandilla King," are cultivated to any extent at the present time. This is largely due to the production of new varieties by cross-breeding and selection, which is a regular feature of the research work of the Wheat Branch of the Department of Agriculture, and in connection with which the late Mr. E. J. Limbourn has done much useful work in the production of "Bencubbin," "Merredin," "Totadgin" and "Noongar." The selection of "Nabawa" by Mr. C. Orchard, at the Chapman Experiment Farm, was the first notable achievement in this connection, and, as indicative of the advancement that is ever to be looked for, it would appear that "Nabawa" which was introduced into cultivation as recently as 1919, is now

likely to be replaced by "Benеubbin." "Noongar" matures very rapidly and is believed to be the earliest variety in cultivation in this State. Its production, or the later production of similar varieties, is likely to make secure the development of that new wheat growing territory lying outside what was the recognised Wheat Belt of a decade ago, and of which Kellerberrin was the centre.

The accidental discovery that "Nabawa" was immune to Flag Smut has rendered possible a new goal for the scientific plant breeder, viz., the elimination of all varieties not immune to this serious disease. In consequence the new varieties "Benеubbin" and "Totadgin" possess this quality and other future introductions must have it.

Coincident with the improvement in the morphological and physiological characteristics of our wheat and oat varieties the milling and baking qualities of the wheat grain have been maintained and, in some cases improved. Despite the present limitations of Cereal Chemistry this has been rendered possible by workers in the laboratory of another past President—Dr. Simpson.

One striking instance of the way in which agricultural research, in connection with the principles underlying the wheatgrowers' practice, has proved of definite economic advantage, is in connection with the very ordinary operation of seeding the wheat crop. To-day, in consequence of the experimental results obtained, the rate of seeding is at least ¼ bushel (15 lb.) less than it was 20 years ago. On the present crop of 3½ million acres the saving in seed would be 875,000 bushels; at the normal price of, say, 3s. 4d. per bushel this is worth £146,000.

Following upon the discovery in 1807 by Prevost (Manual of Plant Diseases, Heald, 1926), that smut spores were of fungal origin, and later the working out of the details of spore germination by Brefield in 1833, measures for the control of "Bunt" and many other cereal smuts by means of fungicidal solutions, were soon forthcoming for the use of farmers. As the result of these discoveries it is possible to eliminate ball smut from our wheat fields, but, unfortunately, farmers do not utilise the discoveries as fully as might be.

A disease known as Septoria, for many years caused tremendous losses in the Geraldton area, and, in 1915, devastated large areas of wheat between Dowerin and Merredin. The fear of this disease has been banished, as the result of the work of the Superintendent of Wheat Farms (Mr. I. Thomas), which has demonstrated the especial importance of sowing varieties in accordance with their period of maturity. In consequence, those farmers who plant varieties at periods which the experiments have indicated the most suitable for them no longer fear Septoria.

Biological control is one of the latest developments of Entomology, and the Entomologist, by its application, has been responsible for the practical absence from our apple orchards of the most serious pest, the Woolly Aphis. It has also been successful in controlling the Mealy Bug, Black Scale, Red Scale in our orchards, Vine Scale in our vineyards, and the Cabbage Aphis in our vegetable gardens. The depredations of many other insects have also been much reduced by the introduction of numerous predators (Lady Birds) and internal parasites. It is interesting to recall that, on my arrival in this State some 20 years ago, the present Government Entomologist (Mr. L. J. Newman) was practically the only Entomologist resident in Australia, who believed and advocated biological control methods; other Entomologists preferred to rely upon the spray pump and other artificial means of control. It is to Mr. Newman's credit that, despite opposition and sometimes ridicule, he has consistently advocated biological control throughout this period with gratifying results. The principle is now generally accepted throughout Australia and in other parts of the world.

The efforts to control Fruit-fly by biological means have not been successful, although various parasites have been tested. In this respect the work in Western Australia is not singular, as similar efforts have been made throughout the world, but without satisfactory results to date. It is however, owing to Mr. Newman's special study of lure, which appeal to the olfactory senses of the pest, that the orchardist can now keep this pest in such subjection, that it need not now constitute a serious menace.

Recently the life history of the Curculio Beetle has been worked out by another member of the Royal Society—Mr. H. Andrewartha—and, as the result, means for its control have been evolved and, in many cases, successfully adopted.

The study of the life history of locusts, has resulted in measures of control which have been placed in the hands of the farmers, so as to deal with this pest at its source, and before it reaches plague form, thus preventing wholesale devastation of part of the Wheat Belt.

Codlin Moth is a much dreaded pest of Pome fruit, and it has been frequently stated and, in some quarters, is still stated that once introduced into a country it can never be eradicated. Fortunately with the aid of Science, and the co-operation of the orchardist, it has been possible to disprove this in Western Australia. In the twenty-five (25) years from 1903 to 1928 there have been eleven (11) distinct outbreaks of Codlin Moth in Western Australia. These have been dealt with and the pest eradicated. The two latest outbreaks were at Collie in 1925 and Narrogin in 1926, but both these areas are now considered clean, for no Codlin Moth has been found at Narrogin since 1929 and Collie since 1930.

The most serious outbreak was in 1915-1916, when this pest made its appearance at Bridgetown, in a commercial orchard thirty (30) acres in extent, and in the centre of one of the largest and best apple districts of the State. Within a radius of three miles from the infested place there were 1,100 acres of orchards, and the planted area has greatly increased since then.

In no case in which this pest has been dealt with has a commercial orchard been destroyed. As far as numbers were concerned the outbreak at Collie was the most violent infestation this State had seen, and it was in some 700 small home gardens around residences that the pest was principally found. In connection with this outbreak a representative body, consisting of the principal apple-growers in the State, waited upon the then Premier, the Hon. Phil. Collier, and, because of the non-commercial character of the trees in which the pest had been found, and owing to their location so close to the main apple orchards of the State, recommended as the only safe treatment the destruction of both trees and fruit. The Departmental Officers in control of the outbreak—Messrs. Wickens and Newman—had, however, so much confidence in their treatment, based upon a knowledge of the life history of the creature, that it was felt unnecessary to take this extreme measure. This was a very bold step to take, for had their efforts been unsuccessful, they would have had to take the risk of the obloquy attached to failure. Had the pest obtained a permanent footing, the opinion would have been strongly held and freely expressed that, if the Departmental Officers had taken the advice of the growers, the pest would have been stamped out. Fortunately, success was achieved, consequent upon the thoroughness of the Superintendent of Horticulture (Mr. G. W. Wickens) and his officers who carried out the details necessary to stamp out the pest.

It is nearly always difficult and sometimes impossible to evaluate the financial benefits derived from the application of science to the solution of an agricultural problem, but in this connection Mr. Wickens has taken the trouble to do so. He

estimates that the loss to the State which would have occurred had the pest obtained a permanent footing, in round figures at not less than £50,000. It is interesting to note that the annual expenditure of the Department of Agriculture, excluding the vote for vermin destruction, is the same.

The co-operative investigation between the Commonwealth and the State, with Mr. W. M. Womersley and Mr. L. J. Newman as investigators, into methods for the control of two very serious pasture and crop pests—the Clover Springtail or Lucerne Flea and the Red Legged Earth Mite—is still proceeding. The discovery of a predatory Mite which attacks the Clover Springtail is encouraging and points to the ultimate control of the Clover Springtail. Unfortunately, no means for the biological control of the Red Legged Earth Mite has appeared on the horizon. The investigators, however, are till pursuing all possible methods of dealing with this trouble.

One of our past Presidents—Mr. W. M. Carne—as senior investigator is associated with a very important contribution of science to the welfare of agriculture in connection with an investigation into the causes and control of Bitter Pit. It will be remembered that in a paper given by him before the Royal Society he, and his collaborators—Messrs. Pittman and Elliott—also of this Society, in studying the physiology of the apple, especially in connection with the maturation process, found that, what was popularly known as Bitter Pit really consisted of two diseases, one of which was a storage trouble, and the other a physiological one, due to climatic conditions. It was shown that the storage trouble, for which the term "Bitter Pit" was retained, can be largely, if not entirely, prevented as the result of picking for market at the right stage of maturity. How valuable this contribution is likely to prove may be judged from the fact that the Council for Scientific and Industrial Research estimated that the annual loss in Australia due to Bitter Pit (Storage) was round about £100,000.

The factors governing the incidence of the second or field form of Bitter Pit, to which the name of "Cork" was given have been investigated and it has been ascertained that, so far as is at present known, it can only be modified to a minor degree by horticultural management.

Allied with the investigation in connection with Bitter Pit were investigations into Water Core and other physiological diseases generally, known as Break-down. The investigations with these have shown, in the case of the "Jonathan" variety, that in taking measures to eradicate Bitter Pit, the danger to "Water Core" is increased proportionately, and, as this is followed in the ship's hold by serious breakdown of the tissues, the obvious conclusion is that this variety is unsuitable for export and should be replaced by others which are suitable. Largely as the result of the investigation which was focussed upon the defects of this variety, this practice is now being followed by orchardists.

A noteworthy contribution has been the eradition of the Black Spot or Scab Disease in apples due to the fungus known as *Venturia insequalis,* as a result of the combination of chemical, mycological and agrostological knowledge. This disease made its appearance from some unknown source at the end of the summer in 1930, in an orchard at Manjimup. So seriously was the introduction of this disease regarded, that the uprooting of the commercial orchard of 17 acres in which the disease was found, was recommended by orchardists generally, and particularly by those in the adjoining districts. Compared with the loss which would have occurred had this disease become established the cost of destruction of a single orchard would have been infinitesimal, but the objection to such a course was the uncertainty as to whether the disease might not also be discovered in other orchards,

when the cost of a general uprooting of orchards would be prohibitive. As a matter of fact about three weeks later a report was received as to its occurrence in an orchard at the Porongorups. It was decided, therefore, to take such steps as the life history of the disease indicated would certainly control and probably eradicate it. The Mycologist advised that the infection was carried over from year to year and was distributed to other places by means of the infected leaves, which fell to the ground in the Autumn. To counteract the danger of the spread of this infection, due to the leaves being blown about by the wind from place to place, the Agronomist's aid was sought in order to secure a plant which could be sown on the orchard and which could be used as a trap for the leaves to prevent their dispersion by the wind. Such a plant was found in a quick-growing variety of oats. It was anticipated that this would hold the leaves and that when these were ploughed in, prior to the release of spores from the leaves in the Spring, re-infection of the trees in the orchard would be prevented, provided that the burying of the leaves was efficiently carried out. To guard against the possibility of the abovementioned burying of the leaves being rather less than 100 per cent. efficient, the Mycologist further advised that certain chemical compounds would destroy the germinating spores if it was deposited upon them.

To provide this measure of protection, the Horticulturist then played his part by thoroughly spraying the trees with a copper compound, so as to provide the lethal trap for the spores. To ensure 100 per cent. efficiency in this connection, the trees were covered with this copper compound three times, from the bud-bursting stage to the fall of the petals, which was the critical danger period under the climatic conditions, which obtained in the district where this disease was being fought. Fortunately, the measures adopted proved entirely successful at both places. Observation the next year showed that, in the orchard in which it was first found, no evidence of the disease was present. In the other orchard at the Porongorups, one apple was found infected and this was destroyed. The treatment was continued and last year no evidence in that orchard was found

The chief contribution of the many, which Botany has made to agriculture, is the census of the plants of Western Australia by our Secretary—Mr. C. A. Gardner. This work is fundamental to the initiation of many research problems in other branches of Science, as well as in Botany, and is preliminary in the production of a State Flora. Other contributions from Botany are the determination and study of the Poison Plants of the State and the identification and suggested methods of control of noxious and other weeds.

The Dairy Industry has been aided very materially by Science. The quantity of pasture has been increased and its quality improved as the result of fertilisation and scientific management, as well as by the deliberate introduction of new and improved pasture constituents. The result of this has been that annual pastures are being superseded largely by permanent ones and the period of active growth is being expedited and extended.

The placing upon the Statute Book of the "Cattle Improvement Act" is the logical and political application of the discovery in Genetics, that productivity is an inherited constitutional character. This law has also been recognised by the farmer by the introduction of egg-laying competitions and by the formation of herd testing and milk recording associations.

The economic foundation of the production and commercial manufacture of butter rests upon one of the discoveries of applied science, viz., a method for the rapid determination of butterfat in milk and cream. In this State the method

in universal use is that worked out by Professor S. M. Babcock in 1890, who then, so that it could not be commercially exploited, patented it for the benefit of dairymen.

In the realm of soil Science, an important piece of work is now proceeding as the result of co-operation between the Lands and Agricultural Departments. This is the Alkali Survey of certain portions of the agricultural areas. This work is in the charge of Dr. Teakle, who has associated with him Mr. S. J. Stokes, of the Lands and Survey Department, who is responsible for the surveys and camp organisation. On the chemical side Dr. Teakle has as his principal assistant a chemist—Mr. L. W. Samuel—who previously had done original work in connection with the technique associated with the building up of the synthetic Hormone Thyroxine.

Western Australia is to be congratulated upon the excellent land classification, which has been carried out by the Survey Branch of the Lands Department. It, however, has been based upon the botanical and field examination of soils without chemical assistance, but, as the result of a rapid chemical reconnaissance, which was carried out by Dr. Teakle, it was definitely shown that such classification, without chemical assistance could not be relied upon in certain districts, to indicate the area and distribution of the land suitable for settlement. The results of further and more detailed surveys by the Chemist and Surveyor have already proved of considerable economic value in two ways. In the first place they have prevented the placing of a number of settlers on land, which these investigators indicate is unsafe, and, in the other direction, they have restored confidence in the settlement of land in other areas about which settlers, owing to other factors in operation, were having some doubt.

Arising out of the problem of the settlement of these alkali lands is another one in connection with which investigation is proceeding, and that is the selection of plants which, because of their natural resistance to alkali, are the most suitable for cultivation on this type of land.

Many more instances of the way in which Agriculture is indebted to Science could be cited, but from what has been stated it must be evident that the fundamental Sciences of Physics, Chemistry, Geology, Botany, Zoology and Genetics have contributed to the advancement of agriculture in Western Australia in all its branches. Few farmers realise this, for the scientific discovery of to-day becomes the common-place of to-morrow. So much is the agriculturalist using the results of scientific investigation, that it is almost correct to describe him as a worker in applied Science, using the discoveries of his brother in pure Science.

Without the traditional experience of centuries which older countries possess Western Australia, with entirely new conditions, could not possibly have made the tremendous agricultural advance it has without the guidance which comes from Scientific research. It is fortunate that the State has provided the research facilities which have made such progress possible. The wonderful successes of the past can, and should, inspire present workers with the hope of similar successes in the future. Let us, therefore, continue to urge that facilities for Agricultural Research be increased to the limit of the State's financial resources, for, as a writer in the Journal of Chemistry, June, 1932, quoting Dr. Ames, states, "Over production can never take place in Arts, Education, *Scientific Research*, or Medicine."

STRANGLES IN HORSES.

(A. McK. Clark, L.V.Sc., Chief Veterinary Surgeon.)

This is an infectious disease due to bacteria, which usually affects young country-bred horses when brought into town and allowed to drink out of public horse troughs. It causes nasal catarrh, and when the lymphatic glands under the jaw are infected they swell and finally form abscesses and swelling of the throat under the throat strap. Its spread is facilitated by the movement of horses. This is especially so when purchases are being made by dealers who collect them in depots prior to sale. The buyers of such horses should, therefore, take care that these animals are free from the disease and are isolated for some four weeks at least before allowing them access to common drinking troughs and mangers. Strangles if treated correctly do not cause a high rate of mortality and can, in the majority of cases, be treated successfully.

Symptoms.—The horse becomes dull, loses his appetite and becomes feverish, temperature rising to 103 deg. F. or higher. Discharge of pus from the nostrils, the mucous membrane being a dark red colour. Sometimes the glands escape infection but usually after a few days they commence to swell and in about 10 days require lancing with a sharp knife. Complications may occur due to extension of the catarrah towards the lungs and stomach, and the germ may enter the general circulation setting up abscesses in the kidneys, liver, lungs and joints. When the temperature rises to 104 deg. to 105 deg. F., it is usually a sign of complications being present, and usually if death occurs it is due to septicaemia. Purpura hæmorrhagica sometimes follows attacks of strangles, in which case the head and legs will gradually become œdematous and swollen and the skin exude serum in patches. The swelling becomes well marked, in some cases interfering with breathing, and most of these cases end fatally after a long illness. Also pneumonia may supervene which invariably proves fatal.

Treatment.—This should consist of actually treating the symptoms as they develop. Affected horses should be isolated and put *out of work* immediately. Place in a loose-box or some area sheltered from draughts yet well ventilated. Should the breathing be distressed it may be necessary to administer inhalations of eucalyptus oil and turpentine. This should be done by placing some straw in a nose-bag and pouring over it boiling water; then add to this one table-spoonful each of eucalyptus and oil of turpentine.

If the larynx is inflamed the animal will have difficulty in swallowing and when attempting to drink, water will flow through the nose. In this case the water should be elevated to the level of the chest in order to assist the horse to drink easily. Ample water should be provided. Do not drench with medicine but give the following electuary:—

Extract of Belladonna, 1 ounce.
Potassium Chlorate, 4 ounces.
Ginger, 4 ounces.
Treacle, sufficient quantity.

One tablespoonful of this mixture should be placed on the tongue twice daily.

Should swellings appear in the region of the throat they should be rubbed for 10 minutes with an ointment composed of Red Iodide of Mercury 1 part, Lard 4 parts, or mustard made into a paste with cold water. When these swellings or abscesses become mature or soft and pointing at the top they should be lanced with a knife and allowed to drain freely. Wash the wound out daily with a disinfectant solution such as Lysol, etc. Feed on green feed or bran mashes and keep the stable and resting paddocks clean.

BULK HANDLING.

A Correction.

In "A Case for Bulk Handling in W.A.," published in the last issue (September, 1932) of this Journal, the financial results of the operations of three farmers handling wheat under the Experimental Bulk Handling Scheme are given (pages 364 and 365). It was shown that the average saving due to handling in bulk in the three cases quoted amounted to 2.33d. per bushel. Since then it has been learnt, as the result of evidence given to the Bulk Handling Commission (*vide* Report, p. 223, question 4930), that the arrangements with the millers, who purchased the bulk wheat, were that the millers be supplied with the number of bags necessary to hold the wheat if it had not been bulked, and that the millers would credit the Bulk Scheme with the savings resulting from handling the wheat in bulk. Though this did not affect the farmers, whose transactions were cited, it is considered that part of the cost of the bags should have been taken into account and the savings, as shown, reduced accordingly. This would have been done had the details of the arrangement with the millers been available at the time. It, however, would not have altered the estimated savings due to bulk handling (page 370) and shown to range from 2.93 to 4.53 pence per bushel, as these final conclusions were not based in any way upon the costs of the experimental installation.

GEO. L. SUTTON.

RYEGRASS—HAWKE'S BAY.

From time to time the Department of Agriculture, per medium of the "Journal" and other advices, has stressed the advantage of seed testing. It is no less necessary that when a high standard has been obtained by a certified grower of seed, the purchaser should be assured that the seed he buys comes from the producer he desires to patronise. We have recently received a communication from Mr. J. A. Simson, the Hon. Secretary of the Hawke's Bay Association of Certified Grass Seed Growers, who, writing from Hastings on the 4th October, states:—

HAWKE'S BAY ASSOCIATION OF CERTIFIED GRASS SEED GROWERS.

P.O. Box 81.

Hastings,
4th October, 1932.

The Director,
Department of Agriculture,
Victoria, New South Wales, South Australia, and
Perth.

Dear Sir,—During the past few months it has been evident that ryegrass grown in Hawke's Bay has been purchased by firms in your State and it has come before us through advertising catalogues where Hawke's Bay ryegrass is being sold but in many cases it has been found that Hawke's Bay ryegrass has not been distributed but is some other certified ryegrass grown in some other province of New Zealand.

In setting out this memorandum I would like to point out on behalf of my Association that as a guide to ensure the farming community of your State that they will be purchasing the genuine Hawke's Bay certified ryegrass by looking for the following markings on bags, tags and insert slips.

As far as our merchants are concerned they always stencil on their bags "Guaranteed Hawke's Bay grown; machine dressed by (the name of the firm)." The Department of Agriculture supervises all the certification and they issue insert slips and tags

according to the classification of the seed. On the insert slips and tags there will be found "Grown on Registered Area No........."; following this will be "H.B./107" (Grower's number), and then paddock letter following the registered number. H.B. stands for Hawke's Bay district, whereas if S.C. was on the tag this would indicate that the area harvested was in South Canterbury. There is nothing really to show the farmer that the seed was grown in Hawke's Bay except by looking for H.B. on insert slips and tags or, in some cases where firms adopt the method of branding the bags, as follows:—2 HB/107 and paddock letter over the code letter for seed classification.

It is my Association's intention to ask the Department of Agriculture to have printed over the tags and insert slips the name of the province in which the seed is grown. For our concern the words "Hawke's Bay grown" would be printed across the tags and insert slips.

This attention was drawn to us by a farmer of your State visiting this locality and he said that there was no guarantee whatsoever from the merchants that the farmer was receiving genuine Hawke's Bay certified ryegrass, and to his sorrow in some cases Wimmera ryegrass has been sold, so he has asked our Association whether it would be possible for us to put up certified seed in containers of three-bushel bags. This, however, is now under consideration with the merchants and Department of Agriculture.

My Association would be grateful if your Department would publish an article, or outline the system, in your "Journal" so that the farmers may be educated up to the idea of what to look for when purchasing the certified ryegrass seed as being advertised by the local merchants. We would not like to see the good name of our perennial ryegrass being abused in any way. This factor alone is of very grave importance to us, particularly where the trading enterprise is just opening up. I am sure if the genuine article is purchased and grown every satisfaction will be obtained as this grass has now been tested out in different parts of the world and has proved itself as to its permanency and good name it attains.

It is somewhat unfortunate that the prices this year have been so high, but this is due to one factor that seasonal conditions in the other provinces have been very adverse to crop production and we are the only province that has made an average harvest, so the demand has been high; thus prices reached a high level. It will probably be found that in future years, when three or four provinces are competing, the prices will be about 50 per cent. lower, and this alone, I am sure, will cope with the wants of our overseas buyers.

Hoping that this favour is not going to inconvenience you in any way, I would like to offer the thanks of my Association for anything that is done to further the interests of our grasses.

Yours faithfully,

(Sgd.) J. A SIMSON,
Hon. Secretary.

HORTICULTURAL NOTES.

Geo. W. Wickens, Superintendent of Horticulture.

At time of writing—November—nearly all kinds of fruits, excepting citrus are sufficiently forward to show that on the whole a favourable setting has taken place, and the outlook for a good crop is decidedly encouraging. The first of the new season's fruits—loquats—appeared on the market some time ago, and it is to be hoped the quality of the first comer cannot be taken as an indication of the standard of those still to arrive. The loquat crop this year was the heaviest I have seen in the State, and as very few growers thinned, there was a big quantity of small and unsaleable fruit.

Stone fruits—apricots, peaches and plums—have set abundantly, and unless orchardists thin drastically, an experience similar to that with loquats will take place.

Pears throughout the State are uniformly good and are freer from scab, Venturia pirina, than for several years past. If the overseas pear market is as good in 1933 as it was in 1932 pear growers will have a profitable export season.

The apple crop is not as easy to gauge now as it used to be, owing to the fact that the thrips visitation in season 1930-31 put one big producing district, viz., Cranbrook, Mount Barker, Albany, out of step with the remainder of the State; but allowing that the district mentioned, which had a very heavy crop last season, will be much lighter this, it is not by any means the failure that occurred in the thrips year, and with a good to heavy crop in other parts the present indications are that the yield for the State will be above the average.

The grape crop varies very little from year to year, and this season promises to be no exception to the general rule of good crops, and excellent quality.

Citrus trees blossomed well and the young fruit at the present time look promising, but it is not possible until after shedding has taken place to forecast what the crop will be.

In the August issue of the "Californian Citrograph" I came across some verses which will bear reproduction in our "Journal," for with the exception of frost, which is a minor danger to fruitgrowers here, the other stanzas might easily have been written for Western Australia, and during a close acquaintance with growers, now extending over 30 years, in which I have seen scale and codlin moth vanquished, hailstorm and drought borne without moaning, bad fruit culled and good fruit well packed, I have definitely formed the opinion that, while no doubt there are some who slip, particularly on the cull pile, it has been my good fortune to meet quite a number of dinkum orchardists.

IF—

(With apple-ogies to Kipling.)

If you can spray when Scale seems cleanly vanquished
And do a real job of it, year on year:
If you can lick the Codler to a finish
And send your fruit abroad without a fear:
If you can watch a hailstorm strip your orchard
Leaving your hopes and work a blasted mess,
And gather up your notes to face the bankers
And do it so the World can never guess:
If you can sleep spring nights as winter clutches
Your slopes, just bursting into pink-white bloom,
And see them in the morning sun change swiftly
From life to deadening brown, yet show no gloom:
If you can watch the Drought burn up your apples
With rainless, dancing dazzle day by day,
And keep on thinning as you watch them shrivel
And still have faith your work is going to pay!
If you can let your apples hang to ripen
Nor yield to crafty pleas to "sell them quick,"
If you can throw ALL bad ones in the cull pile
Nor stoop to cheat with outworn packing trick:
If you can grow one full carload per acre
And pack the way The Public wants it done:
If you'll do these you'll never need financing
And more—you'll be an Orchardist, my son.

WEST ARTHUR PASTURE COMPETITION, 1932.

JUDGE—A. S. Wild, Agricultural Adviser.

The inspection of the 5-acre pasture plots entered in the West Arthur Pasture Competition was made on the 31st October to 2nd November, and awards were made as follows:—

Competitors.	District	Yield.	Freedom from Weeds.	Useful Grasses.	Freedom from Disease	Evenness of Growth	Total
		40 pts	15 pts.	15 pts	15 pts	10 pts	100 pts.
R. Schinzig ..	Duranillin	40	14	12	13	9	89
Mrs. Cameron .	Collie .	27	13	14	14	9	77
Mrs. Cameron .	Collie ..	26	14	14	14	8	76
A Holmes . ..	Duranillin	23	14	13	13	9	72
T. H James ..	Darkan	20	14	14	13	8	69
H. Barton Rodway	Darkan .	18	13	13	13	8	65

The rainfalls as recorded during the year at the centres concerned were:—

Centre.	April	May	June	July.	August	September	October	Total for Growing period
Duranillin	76	492	518	555	265	174	211	2 291
Collie .	188	840	799	1,000	416	266	202	3 728
Darkan .	102	588	443	580	329	98	203	2 343

Mr. R. Schinzig's winning pasture had been established during 1926 on land which had just been cleared of its white gum, jam, blackboy and stinkwood timber. During that year it was ploughed and planted with 60 lbs. of oats and 2 lbs. of subterranean clover seed per acre, while superphosphate was applied at the rate of 90 lbs. per acre. Each year since, it has been topdressed with an application of 90 lbs. of superphosphate per acre during the month of April. Sheep had been depastured on this plot up to the middle of August. It was calculated to yield about 13 tons of green fodder per acre.

Mrs. Cameron's two entries were both from the same property, located about eight miles west of Collie. Both plots had received similar treatment, being cleared of blackbutt timber three years previously. After ploughing, 90 lbs. of unslaked lime were applied per acre. This was followed by an application of 135 lbs. of superphosphate during the next year, when 1 lb. of subterranean clover and 2 lbs. of mixed grasses were sown per acre. During 1932 a bag of potato manure was applied to each acre and, in the case of the first pasture, this was followed by the same quantity of superphosphate. The entry which was awarded second place to that of Mr. Schinzig's was calculated to yield 8.7 tons of greenstuff per acre, although it had been stocked up to the end of September, 40 acres carrying 130 ewes, 77 lambs and 20 head of mixed large stock.

The pasture entered by Mr. A. Holmes had been established on a white gum flat. After being cleared the land was ploughed and seeded with 60 lbs. of oats and 1½ lbs. of subterranean clover per acre, 112 lbs. of superphosphate being applied also. During April of the following year the plot was top-dressed with superphosphate at the rate of 60 lbs. per acre. Early in 1932 the land was again ploughed after the first rains, cultivated, harrowed, and sown with 1½ lbs. of early subterranean clover seed and 50 lbs. of oats, superphosphate being applied at 112 lbs. per acre. This pasture was stocked with cattle up to the end of June.

Mr. T. N. James submitted the same pasture plot which had been inspected the previous year. The land which had carried white gum timber and blackboys had been cleared in 1928, ploughed during October, 1929, and planted at the end of May, 1930. Oats were planted at the rate of 40 lbs. per acre and the very early variety of subterranean clover, "Dwalganup," at 1½ lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre. The first year's growth of clover had seeded well, producing an excellent stand during the second year, 1931, when it was calculated to yield 6½ tons of green fodder per acre, although stocked up to the time of inspection. During May, 1932, the plot was topdressed at the rate of 112 lbs. of superphosphate per acre. It had carried large stock since the 1st of June, but was calculated to yield about 6 tons of green fodder per acre.

Mr. H. Barron-Rodway's pasture had been established for many years on land which originally carried red gum, blue gum and manna gum. It was ploughed first after clearing about 25 years ago, and scarified at intervals of about 3 years, the last scarifying taking place about two years ago. About 80 lbs. per acre of superphosphate are applied to the pasture each year.

CHICKEN REARING.

By A. C. JENYNS,
Poultry Adviser.

This section of poultry farming is perhaps the most difficult, and has certainly the most serious bearing on the future success of the farm. It is a comparatively simple matter to get the eggs hatched, but it is then the *real* trouble begins. If strict notice is taken, the average poultryman will realise that he loses more chicks in rearing than eggs in incubation. This statement will no doubt cause much adverse comment, mainly due to the fact that the comparison has never been made, for I will agree it is not nice, to say the least, to admit to large losses due to no apparent cause.

The first and main cause of chicken morality is due to chills, and once baby chicks get chilled there is little or no hope of cure, owing to the lungs being so easily and quickly affected. Then Cocciodiosis is a disease which seems to be getting a greater hold each season.

In the case of chills there are many causes—incorrect or draughty quarters, and as an even greater cause, too much warmth and close confinement. Chicks are like plants; to be strong and hardy they must have plenty of freedom and fresh air, with just sufficient warmth to counteract any drop in temperature; sunlight and sun heat is the most necessary item on the daily ration. It will be seen, therefore, that the brooding houses and interior systems must be given careful thought before erection. The habit of getting plans and ideas from literature written in other countries or states where the climatic conditions do not coincide with ours is the cause of much trouble and loss, for the best type and position of brooder houses and outside conditions varies with almost every district, and the correct type and position can only be determined by a careful study of the farmer's local conditions, such as angle of sun, winds, and slope of ground, etc. Many a loss from this cause is through the incubator house being too far from the brooders. I have seen many cases where hundreds of chickens have been lost through getting chilled in the transfer from incubator to brooder house. Clean dry sand is the best cover-

ing for the floors of brooders, green chaff should be especially avoided, as this sets up a dampness and humidity which fouls the whole atmosphere of the brooder house.

Coccidiosis.—This disease is spread very often through second-hand incubators, as the germ is left in the machines by affected chickens; then, as many poultry farmers never disinfect and thoroughly clean their incubators, the disease is carried on when machines are sold or changed from one farm to another. Incubators, brooders, brooder and incubator houses should be thoroughly cleaned and disinfected before and after using. Most cases of diarrhoea are put down to coccidia or bacillaray white diarrhoea. This is generally the wrong diagnosis. In my experiments and observations over the past six or seven years, I have proved that in a great many cases the trouble is wrong feeding. By this, I mean that there is too much indigestible matter given to chicks in the early stages. Pollard except in very small quantities should not be fed to young chickens, especially in dry hoppers. Bran should be the main food, with cracked grain at will. I have many times had brought under my notice chickens with pasty vents or what appeared to be diarrhoea. These were being fed on pollard and bran in some cases and gristed wheat (with the flour left in) in others. I immediately caused the ration to be altered to bran four parts, pollard one part, and the wheatmeal to be screened and the flour taken out. Within three days the pastiness had disappeared and the chicks were clean and healthy The increasing use of artificial or chemical foods for chicks is causing the stock to gradually deteriorate. That this is correct is borne out by the fact that trouble with young chicks is increasing more on farms using these foods than on those which are using plain natural foodstuffs.

From the first day baby chicks should be given water to drink and clean bran to pick at, not to be (as is the general method) shut tightly in a small brooder with no free fresh air for three days, but given space to run in and get drink and food when they want it. (Skimmed milk, of course, is preferable to water where available). Where the milk is used the water must also be always available to the chickens. After three or four days gristed wheat in a small hopper should be before the chicks all the time, with a damp crumbly mash consisting of four parts bran to one of pollard or wheatmeal, and two per cent. bonemeal three or four times daily. At three weeks, $1\frac{1}{2}$ per cent. meatmeal to be added to the mash and the size of the cracked grain increased slightly. When six to seven weeks old the mash alters to three parts bran to one part pollard or wheatmeal, increasing the bone meal to $2\frac{1}{2}$ per cent. and withdrawing the meatmeal entirely. This mash, with a gradual increasing of the size of the grain in the hopper will carry the stock till five months old; then $2\frac{1}{2}$ per cent. meatmeal to be added and increased gradually to five per cent. at six months, when the pullets should be commencing to lay.

Though the above method of feeding is antagonistic to most of the prevailing ideas, it will be found correct inasmuch that it will eliminate the great trouble (commonly known as pasty vents) and give greater and quicker body development before sex development takes a hand and starts the pullets laying small eggs, owing to improper feeding and handling forcing sex maturity before the body of the bird is sufficiently developed to do the job efficiently and profitably.

Late hatched chicks (*i.e.*, hatched later than September) are always more trouble to rear than the earlier hatches, and even when reared are more liable to contract sickness and disease. Beginners in buying chicks should stipulate the late July to early September hatches, if they wish to get good healthy and profitable stock. The chief reason for weakness and lack of vitality in late-hatched chicks is the fact that the hens have been laying for a long period and have become stale and lowered in vitality themselves. The male bird has also had a hard long

season and the germ become much weaker, so it will be seen that the combination of these two factors in mating can only give progeny of lowered vitality and resistance to disease. This is especially noticed where large quantities of chickens are hatched and the rearing done in battery brooders or other large scale methods. The battery brooder system has its good points, but I am confident that it tends to the detriment of the chickens raised and so ultimately to the lowering of the standard and vitality of the poultry in Western Australia; for in using battery systems where large quantities are required, it is difficult to avoid using eggs which are obtained from stale hens and more or less devitalised male birds, whereas in proper mating on a small scale, due attention can be paid to these details.

GRADE HERD RECORDING.

G. K. BARON-HAY,
Superintendent of Dairying.

The testing of pure-bred cows has been conducted in Western Australia since 1918, under the Australian Pure Breeds Herd Recording Scheme, but until the present no testing of grade cows has been carried out. This has been mainly due to the belief that the best interests of the State would be served by conducting Pure Breed Herd Recording and assisting farmers in the purchase of pure-bred bulls ex such officially tested cows, in order to grade up the existing milch cows in the State. It was also considered that in view of the very rapid increase in the pasture areas of this State, that all the existing dairy stock would be required for the adequate stocking of these areas, and such cows, although low producers in themselves, were valuable potential breeders of dairy heifers when mated with the type of bulls supplied to farmers. In support of the above it may be mentioned that the area of sown pasture increased in 1922 from 18,441 acres to 339,371 acres in 1931, a truly phenomenal performance.

During the last two years it has been realised, however, and the fact has been brought under the notice of the Department on many occasions, that in the older districts of the State farmers have increased their herds to a size that would warrant culling, and requests have been made for Grade Herd Recording to be carried out. This has not been possible, however, owing to the withdrawal of the Commonwealth grant in 1931 and the State Government not being in a position to finance the scheme without this assistance.

In September, however, the Government secured a grant of £1,000 from the Commonwealth Bank, which has been supplemented, and will allow Western Australia (the last of the States) to institute a scheme for herd recording in Grade Herds.

Some doubts have been expressed as to whether the State is yet in a position to commence Grade Herd Testing, but examples are not lacking in Australia to indicate that the policy now initiated is one that will increase the average production of herds very rapidly. Grade Herd Testing is of comparatively recent origin even in the older dairy States, such as New South Wales and Victoria, but the results in each of these States have been spectacular and well worthy of notice.

Grade Herd Recording was initiated in New South Wales in 1923-24, when 9,000 cows were tested, and the movement was so successful that each year a substantial increase in the cows tested took place, until in 1930 no less than 100,000 cows were under test in addition to Pure Breed Herds.

In Victoria, where the scheme was started three years earlier, 1,600 cows were tested in 1921-22, averaging 165 lbs. of butter fat; in 1930-31 the number tested had increased to 93,664 cows, with the excellent average of 246 lbs. of butter fat per cow, the State average being approximately 156 lbs. per cow, or 96 lbs. per cow less than those cows under test.

In Queensland, where grade herd recording is still in its infancy, it is significant that the yield per cow is the next lowest to that of Western Australia, the latter being the bottom of the list. In Queensland, however, where herd recording is practised, similar remarkable increases are taking place in production as have been mentioned above. The following results of only three years testing obtained in the Atherton Tableland, will prove interesting, especially in view of the low initial production of the cows.

HERD RECORDING IN ATHERTON DISTRICT, QUEENSLAND.

Year.	Number of Cows.	Average Yield Butter Fat.
		lbs.
1927	296	137
1928	419	156
1929	518	168

The present juncture is most opportune to commence Grade Herd Recording, as every dairyman is confronted to-day with the spectacle of falling prices for his main commodity, namely, butter-fat. The reduction of costs is extremely difficult in a young country where farms are still in the developmental stage. One avenue of reduction is by obtaining higher yields per cow, which is practicable whether the farm is highly developed or not. While it is not claimed that herd recording will of itself effect this, it enables the dairy farmer who uses the information obtained by the possession of such records, to eliminate unprofitable cows, and by better feeding methods with the remaining cows, considerably increase his average herd yield.

Results, too, are relatively rapid, and compare favourably with those obtained by breeding from pure-bred bulls ex tested dams, the breeding and culling going hand in hand.

The following table, obtained in Victoria, shows with what rapidity results may be expected:—

HERD RECORDING AND INCREASED PRODUCTION.

Year commencing Test.	Average Yield in First Year.	Average Yield in 1929.	Increase in Average Yield.
	lbs.	lbs.	lbs.
1921	183	257	74
1922	180	259	79
1923	177	269	92
1925	193·5	252	58·5
1926	165	220	55

This table shows that in Victoria an average increase of 55 lbs. was obtained in three years, while in those associations where testing had been in force for longer periods, the increases were considerably higher. If these results can be obtained in this State, and there is no reason why they should not. then the average production of those cows under test will be more than double that of the average cow in Western Australia.

The rules for the conduction of grade herd recording, which are given hereunder, have been designed to further develop the policy of "grading up" herds with the use of pure-bred bulls ex tested dams combined with the culling of low-producing cows.

Rule 6 requires that, within twelve months from the commencement of testing, at least 20 per cent. of the bulls owned by members in a sub-unit shall be pure bred ex tested dams, and this number shall be increased annually until at the end of five years 100 per cent. shall be pure-bred bulls ex tested dams. It is anticipated that this will have the effect of further increasing the demand for pure-bred bulls, and for this reason alone the extension of grade herd testing throughout the State should be advocated by stud breeders.

While it is believed that dairy farmers generally are seized with the value of pure-bred bulls for the breeding of dairy heifers, a fear has been expressed that in individual cases farmers owning a very high-producing grade cow may be tempted to rear a bull calf from that cow for breeding purposes. *Rule 7* provides against such a contingency.

Moreover, in the records which it is intended to keep, the sire and dam of every cow tested, as far as is known, will be noted. In a short time the result will be that such pedigree bulls or particular lines of blood in a breed will become known as prepotent for milk or butter-fat production, and will lead to a demand for pedigree bulls from that particular stud or line of breeding. This again should be of considerable benefit to those stud breeders whose herds are officially tested and whose stock "prove" themselves for butter production.

RULES GOVERNING THE FORMATION AND OPERATION OF GRADE HERD TESTING IN WESTERN AUSTRALIA.

1. The State shall be considered as one Testing Unit.

2. The Superintendent of Dairying shall control the formation and administration of the herd-testing movement.

3. Sub-units may be formed and conducted in suitable centres in dairying districts, and shall be in compact areas so as to avoid lengthy travelling by the Tester in carrying out his duties. Each such sub-unit should contain approximately 20-25 dairy herds with not less than 350 cows.

4. Each Sub-unit shall be given a number for identification and recording purposes.

5. Every member undertakes to effect, and does effect, the culling from the herd of all cows which, having reached the age of six years, have failed in each of two consecutive lactation periods to produce 150 lbs. of butter-fat.

6. Members of each Sub-unit undertake that, within twelve months of the establishment of the Sub-unit, 20 per cent. of the bulls being used for service in the herds of members shall be pure bred and ex dams which have been tested under

Government supervision and have reached the standard prescribed by the regulations governing the testing of pure-bred herds, and that the percentage of such pure-bred bulls shall increase at the rate of 20 per cent. per annum thereafter.

7. Members undertake not to rear any bull calves to be sold for use as sires in dairy herds unless these are ex pure-bred cows and sired by pure-bred bulls.

8. Only Testers in the employ and under the direct control of the Department of Agriculture shall carry out grade herd testing under this scheme.

9. The official testing year shall cover the period from 1st May to 30th April following. New Sub-units may be formed to commence operations at any period between 1st May and 31st October, and in such cases the period of the test shall be from actual date of commencement to 30th April following.

10. Dairy farmers who desire to become members of the State Grade Herd-testing Scheme and join Sub-units must submit for testing and pay fees for every cow in their herds with the exception of those sick, disabled, etc., up to 10 per cent., and shall pay for a minimum of 10 cows. Applications for exemptions must be certified by the official Tester.

11. The Testing Officer shall be supplied with the following details of each cow in each member's herd:—Age, colour, marks or brands, and date of calving, and also the pedigree to the extent known.

12. The following means shall be adopted to identify cows tested:—

(a) Each cow shall be tattooed in the ear with a letter and a numeral indicating the Sub-unit and number in that Unit.

(b) A list of all cows in the herd shall be placed in each milking shed or otherwise available to the Tester.

13. The Testing Officer shall weigh the milk yielded by each cow at each milking during the period of his visit, and shall take fair samples of each cow's milk at the rate of 1 c.c. of milk for each pound weight yielded at two consecutive milkings, and shall ascertain by the Babcock method the butter-fat content of such milk.

14. The Testing Officer shall, if asked, give to the member a check sample of the milk at the same time as he takes his own sample for testing.

15. The Official Tester shall leave with each farmer a duplicate copy of each test day's work made out on the field-sheet provided.

16. *Abnormal Tests.*—In cases of cows testing abnormally, *i.e.*, more than 25 per cent. above or below the normal milk and fat yield at the time of the Tester's last visit, such test shall be discarded and the average of the preceding and succeeding tests taken. Any such abnormality should be shown in the "Remarks" column. Where the first test is abnormal, the production for the first sub-period should be calculated from the average of the two succeeding tests.

17. Fee for herd testing shall be 2s. 6d. per cow per annum, such year to end on April 30th. The fee may be paid on application, or half this fee will be accepted on application, the remaining half being covered by an order on a butter factory payable within three months, such order to be given at time of application for testing.

18. The full fee of 2s. 6d. shall be paid on the estimated number of cows to commence their lactation period by 31st October each year. When any variation occurs, the amount shall be adjusted annually.

19. The fee for newly purchased cows, or cows calving after October 31st and submitted for test, shall be 1s. 3d. per cow, and the official year shall be the broken period up to April 30th.

20. For the purpose of assessing fees due to the Association, every cow once tested shall be deemed to be a cow submitted for test.

21. Testing or membership fees will not be refunded to a member after the first test of his herd has been carried out. If a member discontinues testing after his first or second test, he must continue to pay the instalments on full fee charged for each cow entered for test, except with the approval of the Superintendent of Dairying.

22. Each herd in a Sub-unit shall be tested at least once monthly, the order in which herds are to be tested being decided by the Official Tester, and he shall not notify members, directly or indirectly, of the intention to visit.

23. The Tester shall forward quarterly to the Superintendent of Dairying, Department of Agriculture, a report on the form provided, showing the average progress yields of each herd in the Sub-unit.

24. For the purpose of compiling official records, the lactation period shall commence on the seventh day after calving and be completed on the 273rd day after commencement.

25. In the case of a member commencing to test his herd for the first time, or in cases where it has been impracticable to test any cows until after they have been calved two or more months, such cows may be credited with 60 days' production based upon the first test made by the Testing Officer, unless the owner desires an exemption, which may be granted.

26. In compiling the annual report of the average production of the herd, exemptions may be allowed for such cows as have been sold, or have dried off owing to accident or sickness prior to the third testing period, also for heifers calving under 18 months of age.

27. The Testing Officer shall be provided with food and lodging for himself, and fodder for his horse, free of charge, by the member for whom he is testing during such time as is occupied in testing the member's herd.

WHEAT PRODUCTION COSTS.

GEO. L. SUTTON, Director of Agriculture,

and

I. THOMAS, Superintendent Wheat Farms.

It is not possible to give a general answer to the question, "What is the production cost of a bushel of wheat?" This is because, on the 10,000 odd farms in Western Australia on which wheat is being produced, it is safe to say that on no two of them are the conditions entirely the same. Even if these farms were classified into groups on which similar conditions obtained, it would be found that there was such a wide range between some of the groups that it would still be impossible to satisfactorily answer this question. It is, however, possible to state definitely that, on the majority of wheat farms and at present prices (2s. 6d. per bushel) wheat farming does not pay, and this at once raises two questions: "Why do wheat growers remain on their holdings?" and "How are they able to do so?"

In answer to the first question, it is pointed out that a farm, in addition to being a place where certain commodities are produced by the farmer for sale, is also a home for his family, where many of their sustenance requirements can be produced at a minimum of expense. Quite apart, therefore, from the difficulty of disposing of a highly capitalised property, there is considerable reluctance to

break up the home, often with its many sentimental associations, whilst there is any reasonable chance of being able to maintain it. This raises the second question, "How is it possible to remain on it?"

It can only be in one or probably both of the following ways:—

(a) By the farmer himself working for a low labour income; and

(b) By failing to make due return for capital invested; in other words by not receiving interest for his own capital invested in the farm, or not paying interest on borrowed capital.

To illustrate these two points it is proposed to consider the details of an assumed case of the simplest character. In this the farm is regarded purely as a commercial unit and any return for the farmer's labour, experience, and administration is excluded from the returns considered. Had they been available it would have been preferable to deal with the accounts of an actual farm, but, because of the difficulty of securing such, and the variation between the conditions and individual farms, the *pro forma* transactions of an extremely simple case, not complicated with stock or other transactions has been assumed. The farm is assumed to be the standard area of 1,000 acres, worked by a six-horse team, and with clearing and cropping details as follows:—

		acres.
Total area ...		1,000
Cleared ...		900
Homestead, shelter belts, accommodation paddocks ...		100
Disposal of cleared land—Fallow ...	300	
Crop ...	300	
Grazing ...	300	
	900	

Particulars of cropped area—	
Wheat to be stripped for sale ...	234
Wheat for seed ...	16
Oats—Feed and Seed ...	10
Oats for Hay ...	40
	300

For reasonable facilities only the capital expenditure is estimated to be:—

TABLE I.

CAPITAL EXPENDITURE.

	£
Clearing 900 acres at 25s. ...	1,125
Fencing—7 miles wire and erection (posts cut on farm) ...	160
7 horses—6 for team and one spare at £35 ...	245
1 horse (cart) at £25 ...	25
Harness—eight at £5 ...	40
1 spring cart ...	15
1 cultivating plough (Sundercut 10 disc) ...	55
1 combined cultivator—drill, 16 run ...	79
1 reaper and binder, 6ft ...	79
1 harvester 8ft. ...	158
1 waggon 4 ton ...	87
1 bag loader ...	2
1 wheat pickler ...	5
1 engine—6½ h.p. ...	119
1 chaffcutter, £26, and elevator £11 ...	37
Ironwork for swingle bars ...	3
Tools ...	20
2 cows at £15 ...	30
Tank—2,000 yard at 1s. 6d. and cover, £25 ...	175
House ...	250
	£2,709

Excluding personal expenditure for the farmer's family, and for grain sacks and sewing twine, the annual out-of-pocket expenses are estimated in the table hereunder:—

TABLE 2.

ANNUAL OUT-OF-POCKET EXPENSES.

(Excluding any remuneration for farmer and costs of wheat sacks and sewing twine. Superphosphate bags to be used for oats.)	£ s. d.
Super, 300 acres at 90lb. = 12 tons = £54 and freight	60 0 0
Binder twine—12 spools at 4s. 8d.	2 16 0
Repairs and renewals	30 0 0
Copper carbonate at 2 ozs. bus. 26lb. at 1s. 4d.	1 15 0
Sundries	15 0 0
Oils and fuels	10 0 0
Insurance on crop for hail and fire	10 0 0
,, house, fences, etc.	3 0 0
Vermin tax ½d. in £	1 0 0
Road Board rates	4 0 0
	£137 11 0

From the above it will be seen that, excluding the cost of wheat sacks and twine, the irreducible current expenses amount to £137 11s., say £138, and this is incurred whether the yield is 10 bushels or 30 bushels. The cost of bags is equally an essential current expense but it varies with the yield obtained. This is provided for in the table hereunder, where the cost of sacks per acre is given at yields ranging from 12 to 24 bushels:—

TABLE 3.

OUT-OF-POCKET EXPENSES.

(*Excluding remuneration for farmer*).

Item.	Yield per acre. 12 bus.	15 bus.	18 bus.	21 bus.	24 bus.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Out-of-pocket working expenses (Table 2) ...	138 0 0	138 0 0	138 0 0	138 0 0	138 0 0
Sacks and Twine	38 0 0	47 0 0	56 0 0	65 0 0	74 0 0
Total ... ...£	176 0 0	185 0 0	194 0 0	203 0 0	212 0 0

The above totals are what may be regarded as reasonable irreducible minimum out-of-pocket annual expenditure involved in the production of 12 to 24 bushels, or total productions of from 2,808 bushels to 5,616 bushels.

Assuming the wheat to be sold at 2s. 6d. per bushel at the railway siding the gross returns will range from £351 to £702, leaving balances of from £175 to £490 available to the farmer who has been able to carry out the whole of the work without outside assistance. In many cases additional help will have had to be engaged during the year, and, assuming this to be, say, £39, equivalent to one man for 13 weeks at, say, £3 per week, the balance will be reduced to £136 to £451. These represent the amount available for the sustenance and remuneration of the farmer for overhead charges and profit. In the case of an unencumbered freehold farm

these would be the amounts available for remuneration, depreciation, and interest on capital invested. Ignoring remuneration, which will always be a varying amount according to individual needs and circumstances, it is considered that depreciation is the next item to be provided for, this at 10 per cent. on machinery and 2½ per cent. of permanent improvements, amounts to £79 and reduces the balances to £57 and £372. Interest at 6 per cent. on capital amounts of £162. With a yield of only 12 bushels per acre there is less than £105 to meet this, and, in the case of the 24 bushel yield, the balance is reduced to £210. Provision for the annual Crown rent of £25 would increase the debit balance in one case to £130 and reduce the credit balance in the other to £185.

This item of £25, is the annual instalment which purchasers of Crown Land are required to pay; as it forms part of the purchase money it is really a capital charge, but as it is an amount which has to be met annually by the settler it is now treated as portion of the working expenses. From the standpoint of an accountant such procedure is improper, but wheat production costs on most farms are effected usually beneficially by the interaction of side-line activities. In this simple case the effect of this interaction has not been considered, but having regard to it and to the value of the land for wheat-growing purposes, it is believed that the amount of £25, is a very reasonable annual cost to be charged the cropped land.

In Table 4 are set out these details as they apply to yields from 12 to 24 bushels per acre.

TABLE 4.

WHEAT PRODUCTION COSTS.

Financial results with yield ranging from 12 to 24 bushels per acre.

Item.	Yield per acre.				
	12 bus.	15 bus.	18 bus.	21 bus.	24 bus.
Gross yield (bushels) ...	2,808	3,510	4,212	4,914	5,616
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Gross return at 2s. 6d. per bushel	351 0 0	438 15 0	526 10 0	614 5 0	702 0 0
Out-of-pocket expenses ...	176 0 0	185 0 0	194 0 0	203 0 0	212 0 0
Balance available for farmer's sustenance, extra labour, remuneration, overhead expenses, and profit	175 0 0	253 15 0	332 10 0	411 5 0	490 0 0
Extra assistance	39 0 0	39 0 0	39 0 0	39 0 0	39 0 0
Balance	136 0 0	214 15 0	293 10 0	372 5 0	451 0 0
Deduct—Depreciation ...	79 0 0	79 0 0	79 0 0	79 0 0	79 0 0
Balance	57 0 0	135 15 0	214 10 0	293 5 0	372 0 0
Deduct—Interest	162 0 0	162 0 0	162 0 0	162 0 0	162 0 0
Balance	*105 0 0	*26 5 0	52 10 0	131 5 0	210 0 0
Deduct—Rent	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0
Balance	Dr. 130 0 0	Dr. 51 5 0	Cr. 27 10 0	Cr. 106 5 0	Cr. 185 0 0

*Debit Balance.

From the above table it will be seen that, when due provision is made for all legitimate charges against the crop, on a farm producing about the average yield for the State, viz., 12 bushels per acre, there is a loss of £130 on the year's transactions, and to this loss must be added an amount necessary for the sustenance of the farmer and his family, and remuneration for his labour. If, however, the farm is unencumbered and no interest to outsiders is due, or if the interest could be met from a sideline, such as wool or lamb production, the farmer would have £32, *i.e.*, £57—rent £25, to purchase commodities for his sustenance. With the pecuniary assistance from sidelines as poultry, dairying, sheep and pigs, often run by members of the family, he might be able to carry on, and in many cases would certainly be able to do so if the amount were increased to £111, as the result of ignoring the amount of £79 reserved for depreciation. To do so, however, would be an extremely short-sighted policy, for machines and implements, even when cared for in the very best possible manner, will wear out and must be replaced.

Even in such a simple case as illustrated, it will be seen that, in order to provide for all legitimate commitments before making provision for the farmer's sustenance it would be necessary to have a yield of approximately 18 bushels per acre. Though our average yield is between 12 and 13 bushels it is believed that such a higher yield is possible on very many farms, but, even in such cases, it would be necessary for the unencumbered farmer to forego his interest and, in the case of encumbered farms for the creditors to forego portion or all of their claims. The importance of the industry to the individual and the State is more than sufficient to justify this whilst waiting for the improvement in price which history indicates will surely come.

In Table 5 hereunder will be found details showing the increased income due to a rise in price of from 1d. per bushel to 6d. per bushel for yields of from 12 to 24 bushels per acre:—

TABLE 5.

INCREASED INCOME DUE TO RISE IN PRICE PER BUSHEL.

Rate per bushel.	Yield per acre. 12 bus.	15 bus.	18 bus.	21 bus.	24 bus.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1d. per bushel	11 14 0	14 12 6	17 11 0	20 9 6	23 8 0
2d. per bushel	23 8 0	29 5 0	35 2 0	40 19 0	46 16 0
3d. per bushel	35 2 0	43 17 6	52 13 0	61 8 6	70 4 0
4d. per bushel	46 16 0	58 10 0	70 4 0	81 18 0	93 12 0
5d. per bushel	58 10 0	73 2 6	87 15 0	102 7 6	117 0 0
6d. per bushel	70 4 0	87 15 0	105 6 0	122 17 0	140 8 0

These figures emphasise the importance of improving our efficiency by increasing the yield per acre, for at the extremes shown, with the same improvement in price, the increased income is double that of the other.

Though our average yield is between 12 and 13 bushels, the results of the District Challenge Shield Competition promoted by the Cuming Smith-Mt. Lyell Farmers' Fertilisers Ltd., indicate that much higher yields can be obtained on many farms. In this competition the yields of the total areas cropped by the competitors were compared. During the course of the competition, which was extended over three years and included farms located over the Wheat Belt from North to South,

the total area harvested in this Competition was 92,498 acres and the average yield obtained was 17 bushels 53 lbs. There is every indication, therefore, that by good farming our average State yield can be increased by from 3 to 6 bushels per acre, and thus place the majority of our farmers in a very much happier financial position than at present.

It may be uregd that it is possible to increase the net income by cropping an additional area per unit. It is admitted that, by the use of larger teams and bigger implements, it may be possible to do this in some cases. In the case of the single-man farm unit it is believed that any advantage so gained would be more than offset by the necessity for, and expense of, more labour, or by the additional expense necessary for household requirements due to the neglect to grow those farm products which are suitable for consumption in the home, and which provide the best, though limited, market for the farmer's labour.

In many cases the actual capital invested will be found to be greater than that assumed, for this latter has been kept down to the minimum compatible with the requirements for efficient working. In this connection it may be pointed out that the larger the capital involved the greater is the need for increased yields, and, if a given capital cannot be justified by the average yield obtained, then such capital, whether it be borrowed, or the farmer's own, must be written down.

In Table 6 hereunder the total production costs, as given in Table 4, of the farm have been reduced to costs per bushel:—

TABLE 6.

WHEAT PRODUCTION COSTS.

Cost per bushel.

Item. Excluding farmer's out-of-pocket expenses, and renumeration—	Yield per acre.				
	12 bus	15 bus.	18 bus.	21 bus.	24 bus.
	pence.	pence.	pence.	pence.	pence.
Cost per bushel ...	15·05	12·65	11·05	9 92	9 06
Plus outside labour .	3 33	2·66	2·22	1·91	1·66
	18 38	15·31	13·27	11·83	10·72
Plus Depreciation . .	6·75	5 40	4·50	3 85	3·38
	25 13	20 71	17·77	15·68	14·10
Plus Interest	13·84	11·52	9·12	7·92	6·72
	38·97	32 23	26·89	23 60	20·82
Plus Rent	2·14	1·71	1·42	1 22	1·07
Per bushel	41·11	33·94	28·31	24 82	21·89

From this table it will be seen that, even when the cost of farmer's sustenance and remuneration excluded, with a yield of 12 bushels, approximately the average of the State, it requires nearly 3s. 6d. per bushel to cover all legitimate charges, but this is reduced to almost half this amount when the yield is doubled; again emphasising the tremendous need for improving our yield per acre. Intensive rather than extensive production is, therefore, the dominant need during the present depressed times.

Except possibly on some few very well administered farms, larger than the standard unit, and where very high duty is obtained from each implement and machine used, the financial result of wheatgrowing as a commercial investment is unsatisfactory. Where, however, the farm unit is also the farm home the position is decidedly better. Here the first consideration is, or should be, to provide the household requirements—milk, butter, eggs, meat, bacon, vegetables and fruit, by utilising to the greatest possible extent the facilities of the farm. These will provide a very large part indeed of the sustenance requirments of the farmer and his family, so that the purchased requirements are reduced to a minimum and not amount to a great sum. It is thus possible for a farmer on an unencumbered, or lightly encumbered farm, to retain his home even if the yields are not higher than the State average and the price is low as at present. On a heavily encumbered farm, owing to the interest obligations, the position is more difficult. In such cases it is suggested that, though the details which have been discussed are assumed, the method adopted of dividing the costs into sections is suitable for application to any case by substituting actual figures for the assumed ones; it will then be possible for the farmer to determine what sacrifices it will be necessary to ask his creditors to make in order that he may retain his holding.

AN EARLY STRAIN OF SUBTERRANEAN CLOVER.

By A. B. ADAMS, B.Sc.Agr.

When looking for suitable areas for seed collection of the variety of Subterranean Clover found on the Northam Golf Course (reported in this "Journal," Vol. 7, 2nd Series, p. 540) it was noted that on one area there was a rather similar type of clover but with a distinct difference in the leaf. Seeds of both types were obtained by the writer and the two varieties were sown, in adjoining rows, in the grass experimental area at Muresk by Dr. Dunne.

There proved to be a difference in time of flowering, as the variety now reported flowered about a fortnight earlier than the strain previously noted.

The two strains may be compared as follows:—

Earlier Strain.	*Later Strain.*
Flowering period commences at end of first or early in second week of August.	Flowering period commences during third or early in fourth week of August.
Calyx tube of flower entirely red.	Calyx tube red in the upper portion, green below.
White crescent-shaped mark in leaflet, no brown flecking below the crescent.	White crescent-shaped mark in leaflet, with distinct brown flecking below the crescent

The variety or strain now reported, is almost as early as the First Early variety, but differs from it as it is a few days later in commencing flowering, is somewhat less hairy, and produces larger leaves on the runners.

It has not been possible to trace the origin of either of the strains found in Northam, but it is probable that they were taken there in the seed of the Mid-season variety. The latter proved unsuited to the conditions, while the two former produced more seed, and as it was produced earlier more of it was buried; therefore they were able not only to persist but to spread.

Note on Length of Growing Period of Subterranean Clover.

The Mid-season and Late varieties remain green for from two to three weeks longer than the Early varieties when grown under similar conditions of soil and climate.

TOMATO CULTURE IN WESTERN AUSTRALIA.

E. T. MORGAN, Vegetable Inspector,
Officer-in-Charge Potato Branch.

INTRODUCTION.

The extensive cultivation of the tomato is of comparatively recent years, but it has advanced so rapidly in public estimation that large areas are now planted with this wholesome and delicious fruit or vegetable. With our long warm summer with the mercury sometimes soaring towards 100deg., cold lunches with salad are enjoyed by the majority, the tomato takes its true place, as a salad without tomato is like meat without salt.

From available evidence it appears that the tomato originated in Central South America, and it was known and grown by the natives of Mexico, by whom it was highly prized. Apparently it was not used by Europeans as food for upwards of 100 years after its discovery in America, and it was not until about 1870 that it became recognised universally as an important article of diet. It is now regarded by physicians and dieticians as a valuable source of material necessary to good health and proper nutrition. Prices obtained for tomatoes fluctuate considerably, but remunerative returns are generally obtained for a good article, even during glut periods. The grower who puts on the market soiled, grub-eaten tomatoes cannot hope to secure reasonable returns. It is the careful grower who trains his plants, fertilizes properly, and effectively combats the attacks of insect pests thereby producing a good article, who gets a just reward for his labour.

Prices for early tomatoes are high, and crops harvested in September and October realise anything from £1 to £2 per case. Geraldton and Carnarvon with their early season are first on the market, but quite a large proportion of their crop is exported to the Eastern States where lucrative prices are obtained.

The production of an early crop is an interesting pursuit, as well as a remunerative one, and many growers in the metropolitan area have made large sums of money from relatively small areas. The methods employed are quite simple, but care and attention is necessary to ensure success in this phase of market gardening.

EARLY VARIETIES.

Early large red, commonly known as the crinkled variety, is the most suitable for early cropping. Of the smooth varieties Chalk's Early Jewel and Sparke's Earliana are most popular.

MAIN CROP VARIETIES.

Chalk's Early Jewel, as well as being a popular early variety almost takes pride of place as a main cropper. Matchless, Burwood Prize, Best of All, Stone and Paragon are well tried and suitable varieties. Dwarf Champion is popular with home gardeners. It is a good bearing variety and does not require staking. The skin is of purplish hue, but unfortunately is inclined to crack. The flavour is excellent.

SELECTION OF SEED.

One of the most important factors in the successful culture of tomatoes is the careful selection of seed. There are many strains of the above varieties and the careful grower should endeavour to save the seed from his own plantation, also

great care should be exercised in its selection. Sometimes previous to the first packing, outstanding plants should be marked. This selection should be made on the basis of vigour, freedom from disease, and the amount and quality of the fruit carried by the plant. The fruit should be well coloured, nice sized and firm. A good solid tomato is to be preferred to one having soft flesh. Some growers buy fruit from a neighbour, who has grown a good crop, for the purpose of saving seed. This is the next best method to the above-mentioned selection. Obtain seed from a reliable source, and you will have taken the first right step in the production of the tomato crop.

RAISING OF PLANTS.

The sowing of seed for the early crop may be carried out from April to July, and some means of protecting them from frosts and heavy rains must be adopted. Some growers prepare the seed bed on the lee side of a building, and place stakes around the bed or curved sticks across it, in order to place hessian covers over the plants at night or during heavy cold rains. This is risky, and amongst our most successful growers the usual method is to raise the plants under glass. The initial outlay is rather heavy, but over a number of years the cost entailed is justified, owing to the greater surety of raising plants satisfactorily. Artificial heat is generally necessary, and a very successful and economical way of obtaining this, is by the use of fresh farmyard manure. Horse manure gives best results; cow manure heats too slowly, and poultry manure too rapidly. Horse and cow manure mixed together make a good combination, or if horse manure only is obtainable, it should have about one-third to half its bulk as straw or farm litter. Mix the whole thoroughly together, watering the heap if necessary, and allow to remain for several days until a good heat has generated. Then take the material and form into a heap 2 to 3 feet high. When the heap has been firmed well down, place on it a frame made as follows:—

Take sufficient light timber to make a box frame about 8 feet long by 5 feet wide, or in that proportion. Make the back of the frame about 2 feet 6 inches high and the front, which should be placed facing the sun, about 18 inches. The glass sashes should be placed on top, a beading being put round the edge of the frame in order to hold the glass in place. If glass is unobtainable, hessian may be used as a covering, but this should be fastened to a roller, in order to facilitate the raising and lowering of the cover. The compost heap should be made about 12 inches wider than the frame all round. Seed boxes should then be placed inside the frame. Flat fruit cases are used by the majority of growers and answer the purpose admirably. It is always advisable to obtain unused cases, as if tomatoes have been packed in cases obtained second hand, there is always danger in using them, owing to the likelihood of disease being carried in them, notably Fusarium Wilt. Soil mixed with stable manure should be used, as it is not advisable to use too much artificial manure with soil intended for seed boxes. Smooth the surface and sow the seeds fairly thickly and cover with a shallow dressing of light soil, sand preferred, and water well, using a fine rose on the watering can, or a fine nozzled spray pump. As soon as the seeds germinate, the sashes should be raised to allow of ventilation. Every living thing must have access to fresh air, and every form of life gives off gases, which, if allowed to accumulate, will eventually cause death. Briefly the hot bed should be ventilated every day. The heat of the bed should never be allowed to become excessive, and should not exceed about 70deg. Raising the sashes will cool the bed, and this can be accomplished by placing blocks of wood under the sashes or drawing them back to allow of the circulation of air through the frame. When the plants in the seed box are about two inches high,

they should be pricked out and transplanted into other seed boxes in the frame and spaced 2 to 3 inches each way. This allows of their making sturdy plants and helps to check "damping off," a disease generally associated with over-crowding in the seed bed. It is also advisable to spray the young plants with a weak Bordeaux mixture, using the formula 4:4:100, *i.e.*, 4lbs. of bluestone, 4lbs. of lime, and 100 gallons of water. Commercially prepared forms which are obtainable obviate much time and trouble in this direction. This will tend to check fungal diseases, and the copper solution has a beneficial action on the growth of the plants.

When the plants have attained the height of about 6 inches, they will be ready for transplanting. In order to prepare them to withstand the shock of being moved from the artificial conditions of the hot bed to the more rigorous environment of the open air, the plants should be hardened for a week or more before moving. This is done by gradually lowering the application of water, but sufficient water must be allowed to keep the plants alive and strong.

The ideal method of hardening plants is to have a structure similar to the hot bed frame, which is placed directly on to the ground, provided that the land is sufficiently well drained to allow of the free escape of excess water. The plants in the seed boxes should be placed in this, and can be gradually hardened more effectively than by any other method.

RAISING OF PLANTS FOR THE MAIN CROP.

The seed for the main crop may be planted in the open, when danger of frost is over, generally about September and October. The soil is gradually warming up at this period, and if a fairly sheltered spot is picked no difficulty will be experienced in the raising of plants. In some localities slight frosts are experienced during the above months, hence the necessity, in those parts, of choosing a sheltered position. If, by any chance, plants in the bed suffer from the effects of frost, watering with cold water before the sun's rays strike them will generally save them, as this allows of the gradual thawing of the ice particles and enables the cell sap to be re-absorbed by the plants. It is the quick thawing of the ice particles that causes the death of the plants, owing to their being unable to re-absorb the sap which has been drawn away from the plant cells by the process of freezing.

The soil of the seed beds should be worked into a fine tilth and about 3 feet wide, leaving a narrow path between, to allow of watering and cultivation. The seeds should not be sown too thickly, there should be from 1 to 2 inches between plants. This width enables them to become desirable and stocky plants. The beds should be kept free from weeds, and watered sufficiently to keep up a good growth. If at any time the plants are not thriving, watering with a solution of sulphate of ammonia (a large handful to four gallons of water) will encourage growth, but care should be taken not to apply this stimulant directly on to the foliage, but if unavoidable, it should be immediately washed off.

Seed beds are generally made on old cultivated land, and it is a wise plan to fumigate them in order to make sure that certain diseases are not lying in wait for the young plants. Fumigation is carried out quite simply, on a small area, and is resorted to by many of our most successful growers.

The method usually adopted is as follows:—Using a formalin solution (1 part of formalin to 50 parts of water) the ground should be saturated at the rate of half a gallon per square foot, and covered with bags for one or two days. The bags are then removed, the ground is redug, and left open for two days to allow the fumes to escape. The land is then levelled off and the seeds planted about half an inch deep, in rows about 6 inches apart.

SELECTION OF SOIL.

The ideal soil for the production of the tomato crop is a good sandy loam which can be easily cultivated, thereby retaining moisture. For the early crop, land with a northerly aspect, which is in a warm situation, is the most suitable. Although a sandy loam is desirable, tomatoes are grown on many different classes of soil, but where the land is of a clayey nature, drainage must be provided, also cultivation must be carried out at the proper time, as the working of these soils in a wet condition tends to make the surface bake and crack when subjected to warm dry weather, and moisture is therefore lost. However, when well and properly cultivated much of this type of land is producing good crops. The rich gully land of the hills and the river flats of the South-West are ideal spots for tomato culture. The border land of our peaty swamps is excellent for the growing of early crops, and the swamps have proved themselves to be ideal for the cultivation of the late crop. The Geraldton and Carnarvon districts, with their early season, are favourite tomato growing areas and the acreage is being increased yearly.

DRAINAGE.

Many of our tomato growing localities do not require draining. This is generally the case with the border land of our swamps and on sandy loams with a free subsoil, but where there is excess moisture this prevents aeration, keeps down temperature, and retards plant growth. Soil warmth is greatly increased by proper drainage and this is an important feature when dealing with the production of an early crop. Also, well drained land is workable earlier than one which is in a sodden condition.

IRRIGATION.

The early crop, except in very light porous soils, seldom requires watering as sufficient rain usually falls to see the crop through. If the soil dries out, water must be applied. Water may be supplied by means of furrows or drains, and overhead sprinklers. Overhead sprinkling is the most satisfactory method, and where this system is utilised a very even distribution of water is possible. Where irrigation is practised by means of furrows, great care must be exercised in its application, as too much water is just as detrimental to the growth of the plants as is too little. On well graded land, however, watering is satisfactorily done by this method.

MANURING.

No crop responds more readily to correct manurial treatment than does the tomato. In order that plants may develop and mature normally, ten essential plant foods are necessary. Fortunately for us, most of these elements are contained in our agricultural soils and it is generally only necessary to supply phosphates, potash and nitrogen to ensure good results. These three plant foods must be balanced, as it is impossible for an excess of one constituent to make up for the lack of another. Each plant food ingredient has a duty of its own to perform. Briefly stated, the functions of the main plant foods as stated above are:—

NITROGEN.

Nitrogen promotes the vegetative growth of the plant. Excess of nitrogen with sufficient moisture, tends to make top growth, often to the detriment of the fruiting of the plant. A deficiency of nitrogen is seen in the general stunting of the plants and a yellowing of the foliage. The commonest form of nitrogenous fertiliser used by growers in this State is sulphate of ammonia. It is very soluble in water, therefore is quick acting. Nitrogenous manures, judiciously used, maintains growth at its maximum, without affecting the fruit-bearing qualities.

PHOSPHATES.

Phosphates have important functions to fulfil, particularly the stimulation of root development, whereby a vigorous root system is produced. They also stimulate the flowering system of the plant and hasten ripening. Superphosphate and bonedust are the most generally used phosphatic fertilisers.

POTASH.

Potash is an important constituent for plants which produce mainly carbohydrates, such as starch and sugar. It influences to a great degree the health and growth of plants. Plants are said to be more resistant to disease when well supplied with potash. Potash improves the carrying as well as the eating qualities of the fruit, besides increasing the proportion of marketable produce in the tomato crop. Sulphate of potash is the most generally used potassic fertiliser in this State.

Fertilising, therefore, should be done with a well balanced mixture, and where stable manure is obtainable, this commodity, in conjunction with a dressing of artificial manure, will maintain good growth and produce a satisfactory crop. Where stable manure is not procurable, the ploughing in of green stuff will furnish humus so necessary to our soils As the tomato plant continues fruiting over a rather lengthy period it is a wise plan to fertilise with artificial mixtures at intervals rather than to apply a heavy dressing at the time of planting out. Mixtures that have been found to give satisfactory results are Mount Lyell No. 4, Cuming Smith "E" Brand, and Cresco special potato manure. Blood and bone manure is used by many of our market gardeners with good results, but as the phosphoric acid contained in this mixture is only slowly available, the addition of superphosphate is beneficial. A mixture of four parts blood and bone, two parts of superphosphate, and one part of sulphate of potash is recommended as a good combination for many vegetable crops, and for tomatoes has produced fine crops. It is suggested that from 15 to 16 cwts. is applied per acre, although many growers use a ton or more per acre with increasingly good results. If half the quantity per acre is applied at the time of planting and the other half when the plants carry their first flowers, the results should be most gratifying.

Stable manure may be broadcast and ploughed in prior to planting out, or may be applied in the holes excavated for the reception of the plants, mixing the manure, together with the artificial fertiliser, well with the soil.

Heavy dressings of nitrogenous fertilisers are not advised for the tomato, as rank top growth may be induced to the detriment of the fruiting qualities of the plant. Heavy top growth is not generally conducive to good fruit setting. Where plants have been bearing heavily, a dressing with a nitrogenous fertiliser is beneficial and will prolong the growth of the plant with increased fruit production. Sulphate of ammonia applied near the plant and watered in, if dry weather is experienced, is recommended, or as a liquid manure, a large handful in a kerosene tin of water should be applied round the base of the plant, not allowing it to come in direct contact with the foliage or slight burning may take place.

TRANSPLANTING.

When the plants have attained a height of from six to eight inches, they are ready to be removed to their permanent position. As the plants for the early crops are planted out in the beginning of winter, it is advisable to put the land up in ridges in order to facilitate drainage. The land to be utilised having been thoroughly worked, ridges are quite easily struck out with the plough. Manuring may be done at the time of ploughing. It is suggested that a furrow is ploughed each

way along the line to be planted, which should be marked out with sticks prior to the commencement of operations, allowing about three feet between the rows, so as to leave a V-shaped channel. The manure may be sown along this furrow. If the

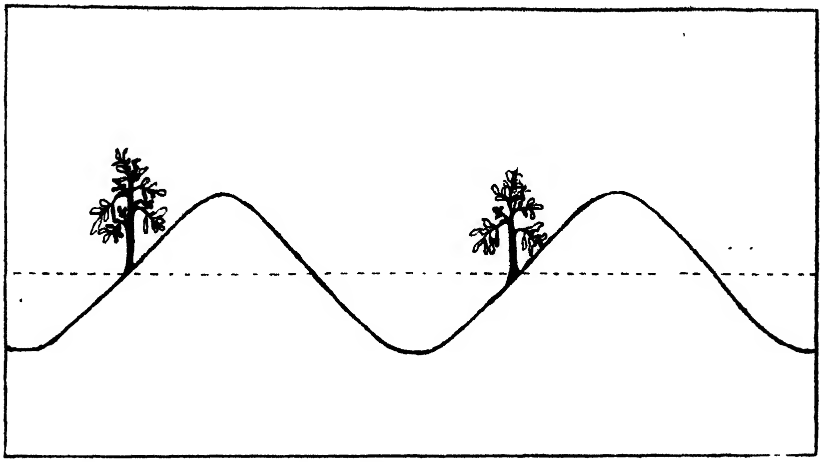


Fig. 1.

depth of ploughing is then increased and the furrows are ploughed back to form a ridge, the results will be a row ready for the putting out of the young plants. The young plants, when removed from the seed bed, should have their roots kept moist and protected from the effects of drying winds, if such obtain at the time of planting. The plants should be placed on the side of the ridge (as illustrated) instead of on the top—the earth at the back making for the protection of the young plants during stress of weather. Later, when the weather becomes warmer, the

Fig. 2.

Early Tomatoes staked and sheltered with palm tops.

whole of the land may be levelled, this process being done without disturbing the root system, so leaving the soil well and deeply worked, and enabling the plants to maintain a regular and healthy growth.

CULTIVATION.

Cultivation should be carried out systematically in order to conserve moisture, aerate the soil and keep down weeds. No hard and fast rule can be laid down as to the number of cultivations necessary. This the grower will decide for himself. Where the land has been well prepared and the soil moisture has been maintained by thorough cultivation, there is seldom any necessity for irrigation in the growing of the early crop, but where irrigation has been done the land should be cultivated after each watering in order to maintain a fine surface mulch and to avoid baking and cracking of the soil.

SPACING.

No hard and fast rule can be laid down as to the distance apart that the plants shall be spaced. This depends a lot on the variety, district and time of planting. When the plants are staked and pruned it is usual to space the rows 3 to 4 feet apart, with the plants about 18 inches to 2 feet apart in the row. This will give ample room to allow of cultivation beween he rows. A width favoured by many growers is 3 feet apart each way. This width allows for good growth of the plant without crowding, and permits cultivations and spraying.

PRUNING.

In order to obtain the best results, tomato plants should be systematically pruned. Pruning often takes place in the seed-bed, as when plants are weak and spindly, pinching out the terminal bud will produce a more stocky and vigorous plant.

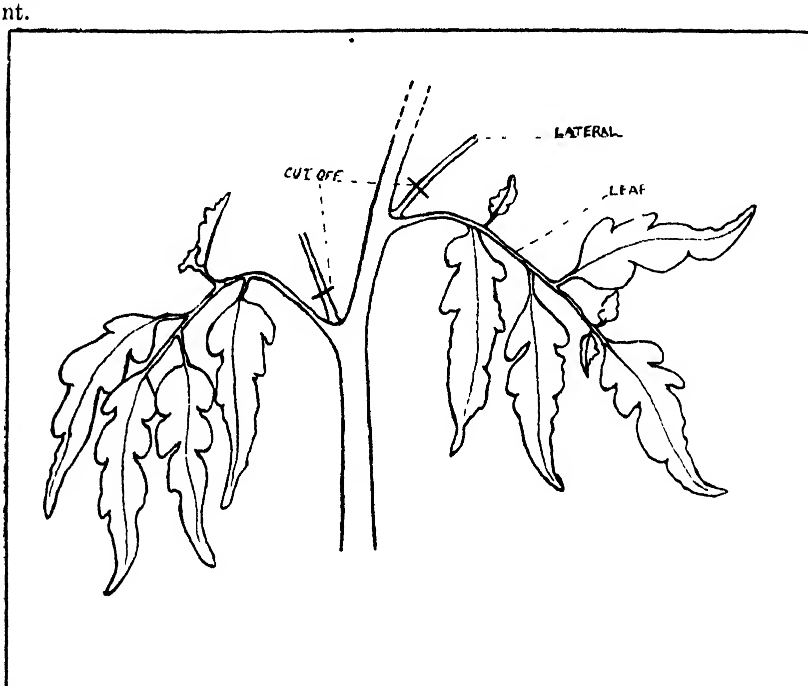


Fig. 3.

The main pruning is done when the plants are put out in their permanent positions, and consists of pinching out the superfluous laterals that start from the axil of the leaves in the main stem or stems (See Fig. 3.)

When the plants are staked, they are usually pruned to a single stem, which is topped when it reaches the top of the stake to which it is tied. The whole energy of the plant is then directed to the production of fruit, but sufficient foliage must be allowed to remain in order to allow of proper assimilation and to protect the fruit from sunburn. Pruning is recommended for the early crop, but the late crop is seldom treated as the hot sun tends to burn the fruit, but some pruning can be done with beneficial results, as the checking of excessive leaf growth encourages fruit production.

TRELLISING.

To obtain the best results, tomato plants should have some kind of support. To allow the plants to roam all over the ground, with the likelihood of the fruit getting dirty and worm eaten, is bad business; rot is encouraged by the fruit lying on the damp ground, cultivation is interfered with, and picking and spraying for the control of insect pests are rendered difficult.

Several methods of support are adopted by growers. Mulching with straw or other litter between the rows is carried out. This method certainly keeps the fruit off the ground, but better results are obtained by staking. Trellising may be carried out by running wires between posts placed at either end, one wire about 2 feet

Fig. 4.

Tomatoes, pruned and trellised.

from the ground, and the other about 18 inches or 2 feet above this, a stake being placed near each plant, so that the main stem may be tied as growth proceeds. Another method is to build a framework with light saplings on the same principle. This is adopted by at least two of our most successful growers in the Balcatta district.

Another method of support, largely adopted in the metropolitan area, is to place four stakes about 4 or 5 feet long around each plant; strips of bagging about $1\frac{1}{2}$ inches wide are fastened round the stakes at about a foot from the ground, and, as growth continues, further strips are used higher up the stakes. It is not advisable to have the stakes too close in to the plant, or the tendency will be for the plants to be bunched too much, and not allowed sufficient sunlight to enable the plant to do of its best and mature its fruit.

GATHERING AND MARKETING.

The exact stage of ripeness at which the fruit is gathered depends on the market to which it has to be sent and the time occupied in the transit thereto. In no case, however, should the fruit be picked until it has fully developed, which does not mean that it is showing colour, but that the pulp surrounding the seeds has filled the inside cells of the fruit and is becoming jelly-like.

In most varieties there is a slight fading of the dark green colour of the skin at the apex of the fruit, as well as slight browning at the point at which the fruit is attached to the stem. If gathered at an earlier stage the flavour will never be fully developed. Gathered at this stage it can be sent to distant markets without difficulty, but where the market is close, the fruit may be allowed to become coloured before being picked. As the fruit, once it has become fully developed, matures rapidly, it is necessary to go over the plants frequently, as if this is not done a quantity of the fruit is apt to become over-ripe and unsuitable for market.

The produce should be handled carefully and all badly blemished or diseased fruit discarded. These should not, however, be left lying on the ground, but should be destroyed, as diseased fruit lying about may be the means of spreading disease throughout the garden.

The sound fruit is taken to the packing shed, where it is graded and packed, usually in cases containing three-quarters of a bushel. Grading should be done on the basis of colour as well as size. It is a mistake to pack green and coloured fruit in one case; if each is placed in a separate case better prices will generally be realised.

BACON CURING ON THE FARM.

By G. K. BARON-HAY.

It is not proposed to deal here with the methods and appliances employed in the curing of bacon on a large scale, but to endeavour to explain the principles and methods applicable to the curing of bacon by individual farmers or householders.

PIGS SUITABLE FOR BACON.

It is essential that pigs for slaughter should be in perfect health. Fortunately the incidence of the two most common diseases amongst pigs, namely, tuberculosis and swine plague, is extremely low. The latter can be easily recognised by external symptoms and the pig exhibits obvious signs of disease. Tuberculosis, however, may be present although not detectable in the live pig, but a useful rule is never to kill an animal for consumption that is losing weight.

Pigs should not be driven hard or excited prior to slaughter, as the flesh is toughened and may not cure satisfactorily.

The best class of bacon is obtained only from young pigs, ranging from 6 to 8 months old, weighing from 140 to 180 lbs. live weight, equal to 105 to 135 dead weight.

SLAUGHTERING.

Farm bacon should be made during the cool months of the year, temperatures higher than 60deg. F. during the day being undesirable. These conditions are found usually from June to September in Western Australia generally, but until November in the South-West coastal areas.

Before slaughtering pigs should be quietly driven into a pen and starved for 24-36 hours, but should have access to plenty of clean water.

The pig should be stunned by a smart blow with a long-handled hammer or back of an axe. The pig is then held on its back or hung by a rear leg and stuck, by inserting a long knife in the throat, immediately in front of the breast bone, with the point towards the tail, and firmly forcing in line with the backbone for 6-8 inches. The blade is then turned completely round and withdrawn. This severs the arteries on both sides, near the windpipe, the blood spurting out.

It is essential that bleeding should be completed, and struggling assists in this object; the pig, however, being unconscious, feels no pain.

SCALDING.

A tub or wooden vat is desirable in which the whole pig can be immersed, but if this is impossible, scalding water may be poured over portions of the pig, these being scraped immediately. The job, under these circumstances, is a tedious one.

The temperature of the water should be from 165-175deg. Fah. It is desirable to use a thermometer to ascertain the temperature of the scalding water, as too hot or too cold will not loosen the bristles.

If wholly immersed, the carcase should be kept moving in order to obtain an even colour of the skin and avoid reddened patches after scraping. After soaking for several minutes, and the hair by test is found to be readily detached, scraping may be proceeded with. In factories scraping is carried out in the tub, but on farms it is preferable to lay on a suitable bench, a convenient form being that of a grid placed over the vat. When scraping start with the head and feet. See that the nose, ears, and feet are made sweet and clean. Finally wash down and remove patches of remaining hairs and scurf with a sharp knife. Should the hair not scrape off easily in certain areas, further applications of hot water should be made. The toenails can be easily pulled off by inserting a hook just above the hoof.

The carcase should finally be washed with clean cold water, and hung by inserting a gambrel through each hock.

CUTTING AND CLEANING.

With a sharp knife cut around the tail and back passage to release from the surrounding tissue. The ventral surface should then be cut through from the tail, along the centre of the belly to the jaw, taking care not to cut any of the internal organs. The breast bone should be cut or sawn through. Grasp the intestines just below the bladder, releasing the back passage if necessary, drawing them forwards and downwards, which will expose the kidneys attached to the backbone.

By cutting at the rear of the cavity just under the kidneys and then around the diaphragm or partition retaining the intestines, the whole of the entrails can be pulled forward out of the carcase, including the intestines, spleen, liver, stomach, heart and lungs, cutting down along the gullet and windpipe to the tongue.

A spreader 9in.-12in. long should be inserted in the flanks to keep the carcase open for cooling, washing and draining. The jaws may similiarly be opened by a piece of pointed stick about 6-8in. long.

The carcase is well washed with clean cold water, rough edges trimmed off, and hung to cool and dry in a dust-free, clean atmosphere for 24 hours.

CUTTING UP.

When the carcase is firm and set, cutting up may be carried out—either while hanging or on a table. The head and trotters are first removed, the former by cutting all round the neck deeply, just behind the ears, force being applied to screw the head off the spinal column.

A deep cut should now be made through the back skin and flesh, close to the backbone, right from tail to end of neck. The ribs are then sawn from each side of the backbone. If these operations have been carried out with the carcase hanging, the sides are now placed flat on a table or bench, insides exposed.

The mesentery or leaf lard can now be removed, commencing near the flank, taking away the kidneys with the lard fat.

Trim the sides all round, removing rough edges of bone, blood and stained pieces. If it be intended to cure the complete side, no further dressing or cutting is required.

The ham may be removed if desired, however, by cutting in a slightly circular shape, commencing at the flank, detaching it from the midde piece or flitch.

The shoulder can be removed by cutting through the side between the fourth and fifth rib.

BACON-CURING.

This should be conducted only during the cooler months of the year, as it is important that as constant a temperature as possible should prevail and that this should not exceed 60deg. F. Lower temperatures and a humid atmosphere are preferable, but these cannot always be obtained on farms, large establishments working at temperatures varying from 40deg.-50deg. Fah.

A cellar makes a good curing room, being cool and moist, and the absence of light prevents bleaching of the red meat.

Bacon may be cured either by the dry method or by pickling in various liquids.

MORDANT FOR FIXING THE COLOUR.

Immediately after cutting up and trimming, the surface flesh should be dusted over with equal parts of fine salt and finely ground saltpetre (potassium nitrate). Only a light dusting is required, which should be allowed to remain for 24 hours, and then washed off.

DRY CURING.

Various recipes are in use for a curing mixture, common salt being the main constituent in all. The use of common salt alone has a hardening effect on meat, and also causes the natural flesh colour to fade, lessening the attractiveness of the bacon.

To correct the hardening influence of common salt brown sugar is commonly used in varying proportions. It also adds brightness, and increases the juiciness and flavour, the sugar also acting as a mild antiseptic.

Saltpetre is usually added in small quantities to preserve the colour. If too much is added the natural colour of the meat is changed to a deep brown, which turns a grey colour on cooking.

The following recipe is recommended by the Hawkesbury Agricultural College, New South Wales:—

Fine dry dairy salt—50 parts by weight.
Brown sugar—5 parts by weight.
Saltpetre, powdered—2 parts by weight.

The mixture should be stored in the curing room for several days prior to use, so as to be the same temperature as the meat.

For the first three or four days after the colour-fixing mordant has been washed off, the above mixture should be rubbed lightly over the fleshy parts and packed round the bones and joints. After the first 3-4 days, the mixture should be spread freely over the sides every 3-4 days, the sides being stacked, and their position in the stack reversed at each handling. The time required for curing is about 14 days.

PICKLING.

Practically every bacon curer has a private recipe for making the pickle; the following, however, can be recommended:—

Clear rain water—10 gallons.
Fine dry dairy salt—25 lbs.
Brown sugar—2½ lbs.
Saltpetre—1 lb.
Allspice—¼ lb.

The quantities given are sufficient for 250 lbs. of meat.

Dissolve the salt, sugar and saltpetre in the water, and immerse the allspice tied up in a calico bag. Boil for one hour and skim off any frothy matter rising to the surface during boiling. Allow solution to cool before use. The sides should be rubbed with salt for two to three days before being placed in the pickle. The time required to pickle varies with the size of the sides, but is usually about three weeks.

SMOKING.

After dry cleaning or pickling, the sides are brushed, any loose pieces of meat cut off, and the meat placed in a vat of cold water containing bicarbonate of soda (1 lb. to every 20 gollons of water) for 24 hours. Remove and wash in a bath of tepid water (blood heat).

The meat is now hung in a clean dry place, in a draught, if possible, until thoroughly dry. It is most important that the meat shall be perfectly dry before smoking is commenced.

Smoking should be carried out in some device which surrounds the flesh with a dense smoke, but without heat. Jarrah sawdust, with a few green twigs or leave amongst it makes a cool fire with ample smoke. The temperature should not rise above 90 deg. F., otherwise the fat will melt and run away from the meat.

Smoking may occupy from one to three days, and is stopped when a light brown or tan colour is obtained. The bacon should be allowed to cool down before being handled. The sides may be given a pleasing appearance by rubbing the skin and flesh with pure olive oil.

In order to keep flies and other pests away during storage the surface may be sprinkled with black pepper or a mixture of black and cayenne pepper.

References—Potts, H. W., "Pigs and Their Management."

FERTILISERS.

N. DAVENPORT, Inspector of Fertilisers.

Provision is made under "The Fertilisers Act, 1928," for the publication of the list of fertilisers registered in this State for each current fertiliser year, which commences on 1st November. The appended table shows the registrations effected up to 30th November of this year.

From the retail prices per ton and the registered percentages of the various fertilising ingredients present in the fertilisers, the unit values for the different forms of nitrogen, phosphoric acid and potash have been calculated, and are shown below together with those for 1931 and 1932 for comparison.

These prices show very little variation from last year's figures. The most noticeable difference is the increased price of potash both in the sulphate and muriate form, the respective increase being 1s. 1d. and 11d. per unit. These increases are due in the main to varying rates of exchange between the Continent, where these fertilisers are obtained, and London and Australia.

There has been a substantial fall of 1s. 6d. in the price of nitrogen in the ammonia form resulting from improved methods of manufacture and keen competition in the trade.

UNIT VALUES.

	1931.	1932.	1933.
NITROGEN (N), as—	s. d.	s. d.	s.d.
Blood and Bone, Bonedust, and Bone and Flesh ...	32 0	24 0	24 0
Nitrate ...	20 0	20 3	19 10
Ammonia ...	12 8	12 6	11 0
PHOSPHORIC ACID (P_2O_5), as—			
Water soluble ...	4 1	4 2	4 2
Citrate soluble ...	4 1	4 2	4 2
Acid soluble in—			
Bonedust ...	...	6 6	6 6
Blood and Bone and other animal Fertilisers ...	6 6	5 6	5 6
Basic Phosphate ...	...	5 6	5 6
Superphosphate and Rock Phosphate ...	2 6	2 6	2 6
POTASH (K_2O), as—			
Sulphate ...	6 0	7 4	8 5
Muriate ...	4 11	5 8	6 7

FERTILISERS.

The following Fertilisers have been registered at the Department of Agriculture, under "The Fertilisers Act, 1928," for the year commenced 1st November, 1932:—

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients. Nitrogen (N), as— Nitrate.	Ammonia.	Blood and Bone.	Bone.	Phosphoric Acid (P_2O_5) as Water sol.	Citrate sol.	Acid sol.	Total.	Potash (K_2O) as Sulphate.	Muriate.	Price per ton on rails at Works or Perth.
			%	%	%	%	%	%	%	%	%	%	£ s. d.
A.—MINERAL.													
1. *Nitrogenous*—													
(a) Nitrogen as Nitrate: Nitrate of Soda ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	15 5	...	...	...	...	...	...	...	...	...	15 4 0
Do. do. ...	do. do. ...	ML in diamond	15·5	...	...	...	..	...	...	...	...	...	15 4 0
Do. do. ...	do. do. ...	CSML	15·5	.	...	..	...	...	...	...	...	...	15 4 0
Do. do. ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ..	15·0	...	..	...	...	...	...	...	...	...	15 14 0
(b) Nitrogen as Ammonia: Sulphate of Ammonia ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	..	20 5	...	...	...	...	...	...	...	...	11 2 0
Do. do. ...	do. do. ...	ML in diamond	..	20 5	..	...	...	...	...	...	...	...	11 2 0
Do. do. ...	do. do. ...	CSML	...	20 5	..	...	...	...	...	...	...	...	11 2 0
Do. do. ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	..	20 5	...	...	...	...	...	...	...	...	11 7 6
2. *Phosphatic*—													
(a) Rock Phosphates: Pacific Islands Phosphate	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	..	..	...	..	...	...	36·65	36·65	...	...	4 10 0
Do. do. ...	do. do. ..	ML in diamond		...	..	.	..	...	36·65	36·65	...	...	4 10 0
Do. do. ...	do. do. ...	CSML ..	...	..		...	...	..	36·65	36·65	...	...	4 10 0
Phosphate Powder ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	..	..	.	.	...	...	34·80	34·80	...	...	4 10 0
(b) Superphosphates: Florida Super 22% ..	Cuming Smith, Mt. Lyell F.F. Ltd.	Sickle	...	...	...	...	20·5	·5	1·0	22·0	...	...	4 10 0
Superphosphate 22% ...	do. do. ...	ML in diamond	..	.	...	...	20·5	·5	1·0	22·0	...	...	4 10 0
Do. do. ...	do. do. ...	CSML	...	..	.	...	20·5	·5	1·0	22·0	...	...	4 10 0
22 Super	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	..	..	...	20·5	·5	1·0	22·0	...	...	4 15 0
Florida Super 24% ...	Cuming Smith Mt. Lyell F.F., Ltd.	Sickle	..	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0
Super 24%	do. do. ...	ML in diamond	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0
Do.	do. do. ...	CSML	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0

24 Super ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...	...	...	22·0	·5	1·5	24·0	...	...	5 0 0
46 Super ...	do. do. ...	do. ...	...	...	...	...	46·0	...	...	46·0	...	...	11 5 0
(c) Rock Phosphate and Superphosphate:													
Phosphate Mixture 50/50	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle ...	...	...	...	...	10·0	1·0	18·0	29·0	...	...	4 11 6
Do. do. ...	do. do. ...	ML in diamond	...	...	...	...	10·0	1·0	18·0	29·0	...	...	4 11 6
Do. do. ...	do. do. ...	CSML ...	...	...	...	...	10·0	1·0	18·0	29·0	...	...	4 11 6
50/50 Phosphate ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...	...	...	9·16	1·84	17·4	28·4	...	...	5 0 0
(d) Basic Phosphate:													
Basic Phosphate ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle ...	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
Do.	do. do. ...	ML in diamond	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
Do.	do. do. ...	CSML ...	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
3. *Potassic*—													
(a) Potash as Sulphate:													
Sulphate of Potash ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle ...	...	...	...		...		...	...	48·6	...	20 11 6
Do. do. ...	do. do. ...	ML in diamond	...		...	...		...	...	...	48·6	...	20 11 6
Do. do. ...	do. do. ...	CSML ...	...	...	...	...		...	...	...	48·6	...	20 11 6
Do. do. ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...	...	...	...	...	...	...	48·5	...	20 0 0
(b) Potash as Muriate:													
Muriate of Potash ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle ...	...	...	...	...	...	...	...	...	...	50·0	16 11 6
Do. do. ...	do. do. ...	ML in diamond	...	...	...		...	...	...	...	...	50·0	16 11 6
Do. do. ...	do. do. ...	CSML ...	...	...	...	...		...	...	...	...	50·0	16 11 6
Do. do. ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...		...	...	...	...	...	...	50·0	16 5 0
30% Potash Salts ...	do. do. ...	do. ...	...	...	...	...	...	...	...	...	...	30·0	8 10 0
4. *Nitrogen and Phosphoric Acid*—													
Ammonia and Phosphate ...	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	2·0	...	...	8·30	1·60	15·70	25·60	...	...	6 5 0
Super and Ammonia ...	do. do. ...	do. ...	...	5·0	...	...	15·37	...	1·13	16·50	...	...	7 2 6
Super and Ammonia No. 1 ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle ...	...	1·5	...	...	16·00	·40	2·10	18·50	...	...	5 9 0
Do. do. do. ...	do. do. ...	ML in diamond	...	1·5	...	...	16·00	·40	2·10	18·50	...	...	5 9 0
Do. do. do. ...	do. do. ...	CSML ...	...	1·5	...	...	16·00	·40	2·10	18·50	...	...	5 9 0
Super and Ammonia No. 2	do. do. ...	Sickle ...		3·5	...		15·00	·40	1·60	17·00	...	...	6 6 6
Do. do. do. ...	do. do. ...	ML in diamond		3·5	...	...	15·00	·40	1·50	17·00	...	...	6 6 6
Do. do. do. ...	do. do. ...	CSML ...		3·5	...	...	15·00	·40	1·60	17·00	...	...	6 6 6
Super and Ammonia No. 3 ...	do. do. ...	Sickle ...		6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6
Do. do. do. ...	do. do. ...	ML in diamond		6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6
Do. do. do. ...	do. do. ...	CSML ...	...	6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6
Potato Manure C ...	do. do. ...	Sickle ...	...	3·5	...	...	15·00	·40	1·60	17·00	...	...	6 6 6
Potato Manure No. 2 ...	do. do. ...	ML in diamond		3·5	...	...	15·00	·40	1·60	17·00	...	...	6 6 6
Potato Manure C ...	do. do. ...	CSML ...	...	3·5	...	...	15·00	·40	1·60	17·00	...	...	6 6 6
Potato Manure F ...	do. do. ...	Sickle ...	...	6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6
Potato Manure No. 6 ...	do. do. ...	ML in diamond	...	6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6
Potato Manure F ...	do. do. ...	CSML ...	...	6·0	...	...	13·50	·40	1·60	15·50	...	...	7 1 6

FERTILISERS—*continued.*

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients.										Price per ton on rails at Works or Perth.
			Nitrogen (N), as—				Phosphoric Acid (P_2O_5) as				Potash (K_2O) as		
			Nitrate.	Ammonia.	Blood and Bone.	Bone.	Water sol.	Citrate sol.	Acid sol.	Total.	Sulphate.	Muriate.	
			%	%	%	%	%	%	%	%	%	%	£ s. d.
5. *Nitrogen, Phosphoric Acid, and Potash—*													
Potato Manure B	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	...	3·75	...	...	14·50	·35	·75	15·60	4·5	...	7 16 6
Potato Manure No. 3 ...	do. do. ...	ML in diamond	...	3·75	...	...	14·50	·35	·75	15·60	4·5	...	7 16 6
Potato Manure B ...	do. do. ...	CSML	...	3·75	...	...	14·50	·35	·75	15·60	4·5	...	7 16 6
Potato Manure E	do. do. ...	Sickle	...	3·50	...	...	14·00	·30	·70	15·00	8·0	...	8 16 6
Potato Manure No. 4 ...	do. do. ...	ML in diamond	...	3·50	...	...	14·00	·30	·70	15·00	8·0	...	8 16 6
Potato Manure E ...	do. do. ...	CSML	...	3·50	...	...	14·00	·30	·70	15·00	8·0	...	8 16 6
Potato Manure G	do. do. ...	Sickle	...	3·50	...	...	10·50	·20	·60	11·30	16·0	...	11 6 6
Potato Manure No. 7 ...	do. do. ...	ML in diamond	...	3·50	...	...	10·50	·20	·60	11·30	16·0	...	11 6 6
Potato Manure G	do. do. ...	CSML	...	3·50	...	...	10·50	·20	·60	11·30	16·0	...	11 6 6
Potato Manure H ...	do. do. ...	Sickle	...	4·00	...	...	12·70	·30	·70	13·70	9·0	...	9 1 6
Potato Manure No. 8 ...	do. do. ...	ML in diamond	...	4·00	...	...	12·70	·30	·70	13·70	9·0	...	9 1 6
Potato Manure H	do. do. ...	CSML	...	4·00	...	...	12·70	·30	·70	13·70	9·0	...	9 1 6
Potato Manure No. 5 ...	do. do. ...	Sickle	...	7·50	...	...	7·00	·20	·40	7·60	13·25	...	11 9 0
Do. do. ...	do. do. ...	ML in diamond	...	7·50	...	...	7·00	·20	·40	7·60	13·25	...	11 9 0
Do. do. ...	do. do. ...	CSML	...	7·50	...	...	7·00	·20	·40	7·60	13·25	...	11 9 0
Orchard Manure	do. do. ...	Sickle	...	2·00	...	...	14·00	·40	1·60	16·00	...	5·0	6 19 0
Do.	do. do. ...	ML in diamond	...	2·00	...	...	14·00	·40	1·60	16·00	...	5·0	6 19 0
Do.	do. do. ...	CSML	...	2·00	...	...	14·00	·40	1·60	16·00	...	5·0	6 19 0
Special Mixture K	do. do. ...	Sickle	...	8·34	...	...	8·40	·20	·40	9·00	...	10·04	10 1 6
Do. do.	do. do. ...	ML in diamond	...	8·34	...	...	8·40	·20	·40	9·00	...	10·04	10 1 6
Do. do.	do. do. ...	CSML	...	8·34	...	...	8·40	·20	·40	9·00	...	10·04	10 1 6
Special Mixture KP... ...	do. do. ...	Sickle	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	10 1 6
Do. do.	do. do. ...	ML in diamond	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	10 1 6
Do. do.	do. do. ...	CSML	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	10 1 6
Tobacco Fertiliser	do. do. ...	Sickle	...	3·30*	...	...	14·00	·50	1·00	15·50	5·70	...	8 2 6
Do. do.	do. do. ...	ML in diamond	...	3·30*	...	...	14·00	·50	1·00	15·50	5·70	...	8 2 6
Do. do.	do. do. ...	CSML	...	3·30*	...	...	14·00	·50	1·00	15·50	5·70	...	8 2 6
Potato Special	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	4·00	...	...	12·50	·50	·75	13·75	8·75	...	9 10 0
Potato Manure	do. do. ...	do.	...	1·50	...	...	7·10	1·40	13·50	22·00	7·50	...	7 12 6
Potato Manure No. 2 ...	do. do. ...	do.	...	8·20	...	...	8·20	...	...	8·20	...	10·00	10 10 0
Mixed Manure	do. do. ...	do.	...	1·50	...	...	7·10	1·40	13·50	22·00	7·50	...	7 12 6

Mixed Manure No. 2	do. do. ...	do.	...	2·00	...	...	16·50	...	1·00	17·50	5·00	...	7 12 6
Mixed Manure No. 3 ...	do. do. ...	do.	...	3·00	...	...	14·00	...	...	14·00	6·00	...	8 15 0
Vine Manure	do. do. ...	do.	...	1·50	...	...	7·10	1·40	13·50	22·00	7·50	...	7 12 6
Orchard Manure	do. do. ...	do.	...	1·50	...	...	7 10	1·40	13·50	22 00	7·50	...	7 12 6
Tobacco Manure	do. do. ...	do.	...	3·30*	...	...	14·20	...	1 30	15·50	5·60	...	8 7 6
6. *Miscellaneous*—													
Super and Manganese * ...	do. do. ...	do.	...	...	...	...	17·00	·50	1·00	18 50	...	...	7 15 0
Crushed Sulphur	Cuming Smith Mt. Lyell F.F., Ltd.	Sickle	...	...	...	...	...	...	...	...	...	...	18 2 6
Do. do.	do. do. ...	ML in diamond	...	...	...	...	...	...	...	...	...	...	18 2 6
Do. do.	do. do. ...	CSML	...	...	...	...	...	...	...	...	...	...	18 2 6
Sulphate of Iron	do. do. ...	Sickle	...	...	...	...	...	...	...	...	...	...	11 1 6
Do. do.	do. do. ...	ML in diamond	...	...	...	...	...	...	...	...	...	...	11 1 6
Do. do.	do. do. ...	CSML	...	...	...	...	...	...	...	...	...	...	11 1 6
B.—ORGANIC.													
(a) Bone Fertilisers:													
Blood and Bone	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	...	...	6·0	...	...	...	12·00	12·00	...	...	10 0 0
Do. do.	do. do. ...	ML in diamond	...	...	7·0	...	...	...	9 00	9·00	...	...	10 0 0
Do. do.	do. do. ...	CSML ...	...	...	7·0	...	...	...	9 00	9 00	...	...	10 0 0
Do. do.	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...	6·0	...	...	...	12 00	12 00	...	...	10 5 0
Do. do.	J. Kitchen & Sons ...	Apollo ...	...	...	5·25	...	...	3 00	12·00	15·00	...	...	9 10 0
Do. do.	Haynes & Clements ...	A1	...	...	5·25	...	...	3·00	9·00	12·00	...	...	11 0 0
Do. do.	Wyndham Meat Works	Wyndham Meat Works	...	...	6·50	...	·09	7·86	3·40	11·45	...	...	10 0 0
Do. do.	W.A. Meat Exports Co.	Eclipse ...	...	...	6·0	...	...	...	12·00	12·00	...	...	9 15 0
(b) Bonedust:													
Bonedust	Cuming Smith, Mt. Lyell F.F., Ltd.	CSML	...	...	...	3·50	...	...	22·00	22 00	...	...	11 0 0
Do.	W.A. Meat Exports Co.	Eclipse ...	...	...	...	3·50	...	...	22·00	22·00	...	...	8 5 0
Do.	Henry Wills & Co., Albany	W in diamond	...	...	...	2·75	...	6·00	13·00	19·00	...	...	9 0 0
Do.	Cresco Fertilisers (W.A.), Ltd.	Cresco ...	...	...	...	3·50	...	...	22·00	22·00	...	...	11 10 0
C.—MINERAL AND ORGANIC.													
Bone and Super	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	...	...	2·0	...	13·00	·80	4·70	18·50	...	...	7 4 0
Do.	do. do. ...	ML in diamond	...	...	2·0	...	13·00	·80	4·70	18·50	...	...	7 4 0
Do	do. do. ...	CSML	...	...	2·0	...	13·00	·80	4·70	18·50	...	...	7 4 0
Domestic Garden No. 1	W. J. Matthews ...	Wondergrowth	...	...	3·75‡	...	12·00	·30	3·20	15·50	...	...	§

* Nitrogen partly as nitrate. † Contains Manganese as MnO, 5.75%. ‡ Nitrogen partly as Ammonia. § Sold in small lots only.

WHEAT—IS IT A SUITABLE FOOD FOR DAIRY COWS?

L. C. Snook, Agricultural Adviser, Dairy Branch.

There exists an unmistakable prejudice against the use of crushed wheat as a food for dairy cattle. As wheat is highly nutritious and is likely to remain a cheap food for some time, it is wise to consider whether this prejudice is justified. Until recent years wheat grain has been too valuable a product to feed to livestock in any quantity, but the question of cost no longer restricts its use. Is there any definite reason why crushed wheat should not become an important food for dairy cows?

A foodstuff, to be satisfactory, must be:—

1. Economical,
2. Nutritious,
3. Palatable,
4. Free from harmful after effects.

Consider crushed wheat under these headings. Perusal of the table of comparative food values on page 559 shows that wheat is undoubtedly an exceedingly cheap foodstuff—it is the cheapest source of carbohydrate on the market and is as cheap a source of protein as linseed meal.

Wheat is a highly nutritious, easily digested, concentrate. It contains between nine and ten per cent. of digestible protein and has an energy value of 72, as compared with oats 60, and bran 50. Wheat grain is rightly considered as one of thet best foodstuffs available.

Crushed wheat is greatly relished by livestock and it often improves the palatability of the whole ration. Crushed wheat should prove an ideal supplement for high producing cows who have to be encouraged to eat to their maximum capacity.

The most important question, however, is whether the feeding of wheat will prove injurious to milking cows. Most farmers are aware of the excellent feeding value, but are dubious about deleterious after-effects.

Two possible evils are anticipated. Some consider that as wheat contains a poisonous principle capable of causing founder in horses, this same substance may also affect the cows. It is very unlikely that trouble will arise from this cause. Henry and Morrison make the following statement. (1) "The germs of the wheat grain contain a substance which is somewhat poisonous when wheat is fed in large quantities, though in the amounts and combination in which wheat is usually fed to dairy cows, there is no trouble from this substance." It should also be remembered that even horses may be fed large quantities of wheat grain with impunity, once they are accustomed to the ration. Sudden changes of diet are always liable to cause digestive disturbances and it would only be common sense to commence feeding wheat in small amounts, gradually increasing the ration to the maximum desired. Where this is done no trouble should be experienced with the reputed toxic substance present in the wheat grain.

An alternative disadvantage has been suggested in that crushed wheat may prove very difficult of digestion, as it tends to aggregate into glutinous masses impermeable to digestive juices and impeding regurgitation (chewing of the cud). This appears a possibility where wheat constitutes the bulk of the concentrate ration and is not fed in conjunction with much roughage. However, interesting experiments carried out in U.S.A. indicate that even under such unusual feeding conditions, trouble from this reason is not likely to occur. The rumen or first stomach of the cow is a very muscular organ capable of quickly disin-

tegrating "boli" or aggregates of sticky food, the food eaten in the bails being quickly mixed with the roughage collected in the field. At Michigan Agricultural Research Station (2) equal parts of linseed meal and ground corn (this mixture when moistened forms a most cohesive mass) were fed to cows which were slaughtered at varying intervals after ingesting the food. The rumens were examined and although no roughage was given and the mixture is considered unusually "heavy" hardly any "boli" remained in the rumen at the end of one hour. This being the case, one can hardly expect that crushed wheat, fed in moderation and with other foodstuffs, would prove unduly tenacious and indigestible when fed to cows.

It has been very difficult to obtain information on the feeding of wheat to cattle, both from text-books and practical farmers. However, the following details have been collected and should prove of interest.

Kellner is the only writer who definitely attributes evil properties to wheat as a cattle food. He states (3) that—"Wheat is also dangerous, being liable to upset the digestive organs—it is best used for fattening cattle and pigs to which it is given ground or crushed."

But if it can be used for fattening cattle why should it prove harmful to milch cows?

Two American investigators, Larson and Putney, hold a different opinion and state (4) "Wheat may be substituted for corn in a dairy ration. It is even a little higher in feeding value. It is altogether a good feed for dairy cows because of its palatability. Use limited only because it is more expensive than corn (maize grain)."

As long ago as 1895 experiments in Denmark (Copenhagen Station) indicated that ground wheat was fully equal to a mixture of barley and oats.

Experiments abroad do not necessarily give a true index of the results which will be obtained in Australia. For this reason the statements of Maynard, the editor of the Australian "Livestock Bulletin," will carry considerable weight with local dairyman. He states (5) "Wheat is used very little in Australia for feeding dairy cows, but the author has used it with satisfactory results when corn was dear and wheat cheap. Dairy farmers can be sure that when wheat is cheap it can be fed profitably to cows."

Endeavour to ellicite definite information from local farmers has proved somewhat unsuccessful. Very few dairymen appear to have fed crushed wheat in sufficient quantities over a lengthy enough period to express an opinion on its value as a cattle food.

Fortunately, Mr. A. P. Herbert, of Nungarin, has been feeding wheat to his stud Jersey cattle for a number of years and has given this Department the benefit of his practical experience. The "Nooka" herd has been officially tested for over two years, hence both production and feeding methods have been checked. Crushed wheat is the basal constituent of Mr. Herbert's concentrate ration, which consists of equal parts of crushed oats, crushed wheat and bran. At various times when bran has been difficult to procure and when the supply of oats has been low, wheat alone has been fed to the cows (along with roughage) without any diminution in the milk yield. As much as eight pounds of crushed wheat has been fed per head per day without any apparent deleterious result. "Nooka" cows under official test have produced remarkably well when tested during the long, dry summer and one must assume that the use of wheat has contributed in no small measure to the success attained. And surely if the use of crushed wheat will result in evil after-effects, Mr. Herbert would have obtained evidence thereof during the long period he has been using this foodstuff.

Wheat has certain distinct characteristics which definitely influence its use as a foodstuff. First and foremost it should be remembered that wheat is a starchy food; it has an abuminoid ratio of 1 : 7 (*i.e.*, the ration of protein to non-protein is as 1 is to 7.) This is too wide a ration for milk production and some protein-rich supplement must be used, except where ample leguminous roughage or grain is available (crushed wheat is a logical concentrate to use in the "clover belt.") Meatmeal should prove an ideal protein food to use in conjunction with wheat. One hundred lbs. of crushed wheat mixed with 10 lbs. of meatmeal would cost about 7s. at current Perth prices. Four lbs. of this mixture, costing about 3d., would, when fed in excess of maintenance requirements, contain ample nutrients to produce one gallon of milk (6). If milk is worth 6d. per gallon it would be profitable to increase the amount of this mixture which is fed as long as one pound of concentrate increases the milk yield by $1\frac{1}{2}$ lb. The only method of determining the profitableness or otherwise of feeding concentrates is to weigh the milk and note the increase which is obtained for the extra food supplied.

The mineral content of wheat should also be noted. Wheat grain is rich in phosphates and its use will tend to eliminate the phosphate deficiency so troublesome in this State. But wheat is also very deficient in lime, a mineral equally essential to lactating animals. Legumes are very rich in lime, this being another reason why they are so valuable as a food for dairy cows. Cattle restricted to a cereal diet require some sort of calcium supplement. Meatmeal contains varying amounts of lime, but not enough to rectify the deficiency of a cereal ration. In the absence of leguminous roughage (clover hay or silage, lucerne, etc.), livestock should receive about 2 per cent. of bone-meal in their concentrate ration, or alternatively, quick lime should be slaked in the drinking water.

One may summarise as follows:—

1. Wheat is at present prices an exceedingly cheap foodstuff; it is nutritious, palatable and easily handled.
2. Where wheat is first used in small quantities, it does not appear that evil effects will follow its use.
3. As much as 8 lbs. of crushed wheat has been fed per day to high producing cows in this State without obvious harmful results.
4. Only use wheat to the extent of a maximum of half the concentrate ration, until experience warrants its use in larger proportions.
5. Wheat is a starchy food with an albuminoid ratio of 1 : 7.
6. Meatmeal appears to be a suitable protein-rich supplement to use in conjunction with crushed wheat.
7. Four pounds of a mixture of crushed wheat (100 parts) and meatmeal (10 parts) contain ample nutrients to produce one gallon of milk, and costs about 3d
8. Wheat is rich in phosphates but deficient in lime. Cows on a cereal diet need some additional supply of lime.

LITERATURE CITED.

(1) Henry & Morrison—"Feeds and Feeding," page 118.
(2) Journal of Agric. Research, May, 1932.
(3) Kellner—"Scientific Feeding of Animals," page 142.
(4) Larson & Putney—"Dairy Cattle Feeding and Management," page 92.
(5) Maynard—"Australian Dairyman's Handbook," page 310.
(6) It is assumed that the production requirement of one gallon of milk is $2\frac{1}{2}$ lbs. of S. Equivalent including half a pound of digestible protein.

THE BLACKBERRY OR BRAMBLE.

(*Rubus fruticosus, L.*)

C. A. GARDNER, Government Botanist.

A NOXIOUS WEED.

The Blackberry, or Bramble, is a European plant which has, for many years, been established in the moister situations of the older established parts of the South-West. That it has not become more serious is due to the moisture-requirements of the plant which limit it to such places as stream banks or soils which retain available moisture throughout the summer. In New Zealand and in South Eastern Australia, where such conditions are more general, it has developed into a very serious weed, but it need not be feared that such will be generally the case in South-Western Australia, except in the above mentioned places. The plant is most prevalent in the Bridgetown, Donnybrook, Greenbushes and Boyanup districts and the environs of Bunbury, and at several places between there and Perth along watercourses, especially the Serpentine River. To a less extent it is found in the Darling Range, and small patches may be found as far east as Brookton, but in this last-named locality it does not produce much growth, and consequently is not as serious as in the higher rainfall areas.

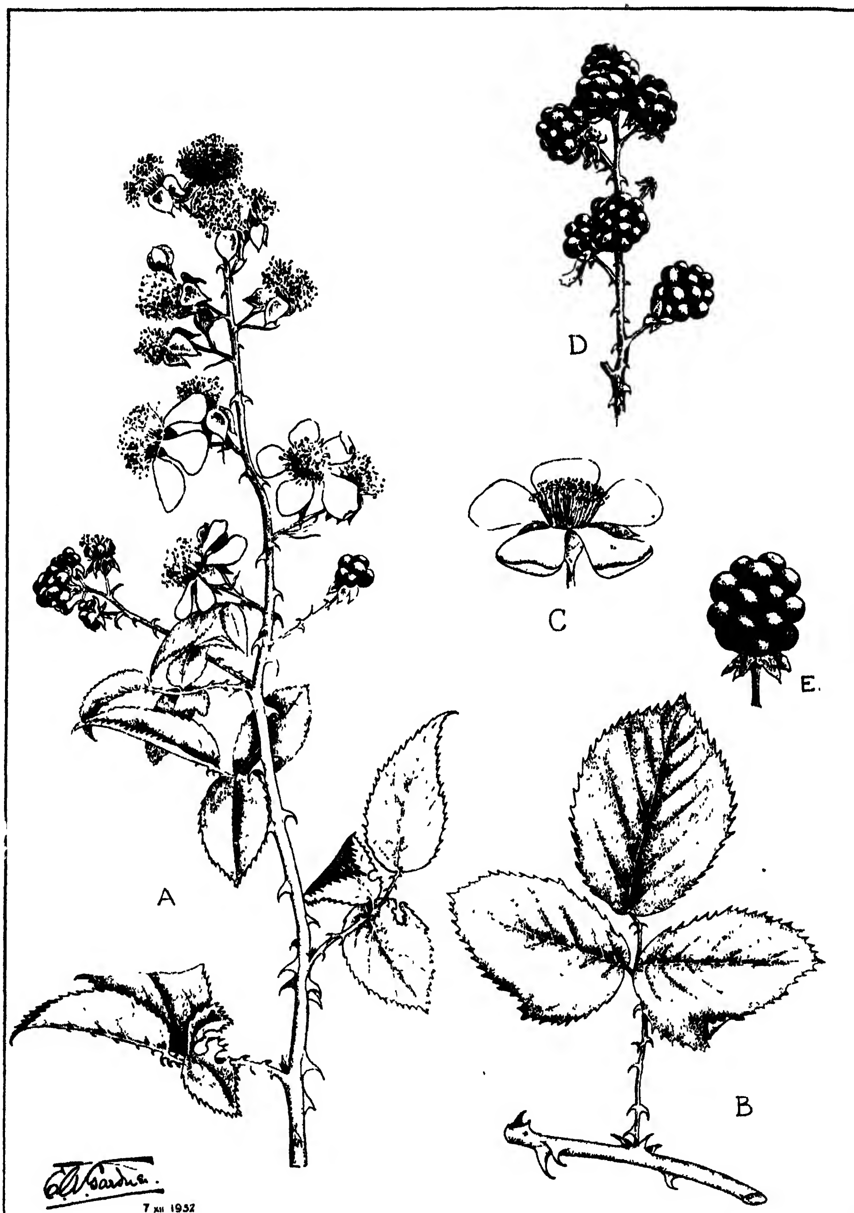
The Blackberry is a proclaimed Noxious Weed for the State of Western Australia, but the problems attending its eradication are confined to the summer-moist soils of the South-West, where, if left unchecked, it is likely to prove troublesome. The principal disadvantages of the plant, are its tenacity, and the dense, impenetrable growth formed by its thorny stems which spread by means of suckering, so that a single plant can, in a short time, cover many square yards of ground, occupying good land to the exclusion of productive plants, and always advancing.

Once established, the plant is difficult to eradicate, since the roots repeatedly produce fresh brambles (stems) which, the more they are cut back, the thicker they grow. Mechanical eradication is an arduous task, and is expensive because of the necessary repetition of operation. Burning only serves as a temporary check, and thus has little ultimate effect. The most successful treatment appears to be the use of chemical sprays. Good results have been obtained by spraying with sodium arsenate and sodium chlorate, especially the latter. Sodium chlorate should be used in a 10 per cent. solution, applied during December or January. The solution should be applied in the form of a very fine spray, and care taken to moisten as much of the foliage as possible. This is essential, since the action of the poison takes place through the leaves, by which it is absorbed and carried down the stems into the roots, killing the plant downwards.

Where a dense bank of Blackberry is to be treated it is often quite impossible to entirely cover the leafy areas in a single operation with the spray, owing to th density of the growth. An initial spraying will, however, kill the superficial areas, allowing of an effective treatment of the underlying portions later on.

If the dead stems and leaves are to be burned, burning should not be resorted to until the chemical has killed the stems back to the roots, otherwise its action is arrested. This also applies to the cutting back of the stems. The spray should produce its maximum result within four weeks, and no burning or cutting should take place until this time has elapsed after the spraying operation.

Experiments conducted by Messrs. Meadly and Elliott, of this Department, in January, 1930, were successful in completely eradicating clumps of Blackberry at Jarrahdale which were about 6 feet high and 20 feet in circum-



Blackberry.

ference, by burning, five or six weeks after the application of a 10 per cent. solution of sodium chlorate. The new shoots which had appeared by the time

that burning was resorted to were thus given a set-back, and the remaining dead stems were cut away. A further growth some time later was sprayed with a 10 per cent. solution, which completely killed the plants.

See "Chemical Weed Killers," by H. G. Elliott and G. R. W. Meadly, Leaflet 330.

For particulars of the plant see accompanying plate.

EXPLANATION OF PLATE.

A. Twig, showing habit (reduced).
B. Leaf, slightly less than natural size.
C. Flower (natural size).
D. Fruits (slightly less than natural size.
E. Fruit (natural size).

Whitby Falls, Western Australia .. .. .. Icon. origin.

THE RACKING OF SEED POTATOES.

J. C. PALMER (Dept. Agric.), Potato Inspector.

The practice of racking seed potatoes prior to planting is one which is adopted in many of the potato growing areas of the world. It is followed in countries of such widely divergent climates as that of Canada and Ireland. Though, in general, the potato growers of Western Australia do not rack their seed, yet the majority of the more successful ones do make this practice a general part of their routine work. This is the case, more particularly in the Albany and lower South-Western districts, and raking could be introduced profitably in some of the other potato areas.

Methods of Racking.—In some localities the growers tip out their seed in a thin layer on the ground, on the floor of a shed, or under the shade of some bushes on old bags. This, however, is not a practice to recommend except in those cases where the grower has no better facilities for racking. The objections to this method of handling seed are that inspections during the greening stage are more difficult and the tubers are liable to become infected by soil-borne diseases such as Rhizoctonia and Blight, more particularly where the potatoes are spread out on old bags.

A better method of handling seed is to tip it out in thin layers on racks or in sprouting boxes. Such potatoes are left exposed to air and sunlight, though, of course, direct sunlight is kept away from them by shading in some way.

In some districts, the racks are spread out in the shade of trees; in others, they are placed in rough sheds—open on all sides except the weather side. Some growers again place their racks in heaps in the open and then cover them with a light covering of hessian or of boughs.

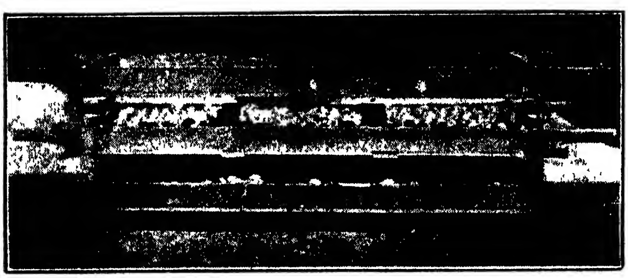
Types of Racks.—Various types of racks are used and it is more or less a condition of local practice which is the best type to use. A very useful type for a man with a small area is one which is used extensively in the market-growing areas of England. This "sprouting box" is simply a shallow box with handles so that it can be carried about. In the Albany district a variation of this is seen where half kerosene tins are used. The seed is "greened" in them and handles are fitted in when occasion arises to move the tins to the field at planting time.

This Department always racks the seed used in the various manurial trials. The rack used is of simple construction—made of jarrah, and the "floor" of it covered with wire netting. Details of this rack are given below. It is constructed of 6 in. x 1 in. jarrah and 2 in. wire netting, with 2 in. x 2 in. legs with a clearance

A Seed Rack.

of 4 in. Such racks will hold about a bag and a half of potatoes and can be handled by two men. Further, this type can be stacked one on top of the other in any convenient place.

The cost of construction is relatively light. Some growers—more particularly in the Denmark area—use "bush" racks. These consist of wire netting roughly nailed to bush poles and laid on poles or black-boy stumps. The difficulty of such racking is that of filling the bags and lack of portability.



Method of Stacking Racks.

Labour Involved.—Racking, of course, necessitates a certain amount of labour. The potatoes have to be emptied out of the bags on to the racks and then placed back again in bags prior to planting. Further, while the potatoes are on the racks they have to be turned over, and all potatoes showing signs of rotting or disease removed. Still, as an offset to this question of labour, the work could be performed at odd times during any spare time that the grower may have. After all, the labour is justified if an increased crop is obtained later on in the paddock.

When potatoes are stored in sacks, more particularly under more or less dark conditions, they sprout. Such sprouts are long, thin, weakly-looking, whitish growths and, being very brittle, are easily knocked off the tubers in the cartage to the planting area. A certain amount of vigour is withdrawn from the tuber in the formation and growth of the sprouts, and should any, or all, of these be knocked off, it follows that there is a definite loss of strength in the seed; further, the succeeding shoots will not be as healthy as the original ones.

When potatoes are racked properly, the sprouting is checked to a certain extent. The sprouts which are formed are short, sturdy and healthy, and coloured according to the variety of the potato. With "Delawares" these shoots are of a dark green colour. When potatoes with good, strong, vigorous shoots are planted, they "come away" earlier, and from them can be expected healthy plants.

Greening.—One great advantage of racking is that during this process the skin of the tubers becomes greener and harder. Such "greening" tends to promote an early maturity and, further, it renders the tubers less susceptible to insect and fungus attack. Another advantage is that the hardening of the skin of a well-"greened" potato renders the tuber practically immune from infection from the soil. All potatoes must go through a resting period before they will make fresh growth, and racking tends to arrest the growing period, and so the resting period is passed through earlier than with potatoes stored in bags in sheds. Under the latter treatment, of course, the tubers are maintained at a more or less warm temperature and so the resting stage is delayed.

What to Look For.—Perhaps one of the greatest advantages of racking is the detection of disease in the potatoes so treated, as any abnormality can be quickly noticed. Inspection alone will enable the grower to weed out of his tubers all those which are of an undesirable shape, or of a variety foreign to the bulk of the sample. These should include all potatoes which are pointed at the end or unduly elongated, as such specimens may be infected with virus trouble or Rhizoctonia. Of course it is impossible to be definite in such cases, but it is better to be too drastic in the rejection than to risk having a poor crop to dig. One definite abnormality can be detected, and that is "thready eye" or "spindle sprout." Instead of healthy, normal sprouts, the tubers send out thin cotton-like shoots, which will never develop into strong, sturdy plants, even if they develop into plants at all. The practical grower will never plant such tubers, whatever the cause of the "thready-eye" may be, as he is anxious that every "set" shall develop into a healthy plant.

During racking—especially when the racks are left in the open—dirt and extraneous matter is washed away. This gives the grower an opportunity of estimating the amount of Rhizoctonia infection of his seed. The resting stage of this disease is shown by small black, earth-like spots in the skin of the tubers; dirt washes off, but Rhizoctonia does not. If it is found necessary to treat the seed for this disease, and it is always advisable to do so, it should be dipped before the shoots are too far developed.

Some of the potatoes may be infected with one of the wilts, either fusarium or bacterial. Such tubers will go soft and should be removed to prevent a possible infection of healthy seed.

Even the most careful of diggers is liable to injure the skins of potatoes when digging the crop. This injury may have become infected with disease from the soil during the picking up. A callous may form over such injury, or on the other hand it may not. Sunburn causes many potatoes to grow soft by breaking down the cells at the injured places in the skin. Racking shows all injured potatoes which can be rejected if necessary.

Since racking affords an opportunity of rejecting unsuitable and diseased seed, it is obvious that the crop from such seed will be—other conditions being equal—a heavier one than that obtained from unracked seed; thus racking is recommended as a profitable part of the routine work of every grower of potato crops. The aim of the grower should be selection of the best type of seed, and racking is a valuable aid in this direction, and the more vigorous his selection and rejection of the unfit, so the better chance he has of growing a high tonnage to the acre.

DISINFECTION OF TOBACCO SEED.

EFFECT ON GERMINATION.

G. R. W. MEADLY, B.Sc.,
Agricultural Adviser.

Owing to the fact that diseases of tobacco, particularly Blue Mould (*Peronospora sp.*) under local conditions, may be carried by means of seed infection, treatments have been devised for the surface disinfection of tobacco seed before planting. The one generally employed and recommended by the Department is to soak the seeds in absolute alcohol in order to destroy any infection present on the outside of the seeds. The seeds are held in a piece of muslin which is folded into the shape of a bag, tied, and the whole immersed in absolute alcohol for five minutes. When taken out, the seed is drained, spread on blotting paper, and dried as quickly as possible. The mass is frequently stirred, and an electric fan or radiator is also sometimes used in order to hasten the evaporation.

A number of inquiries have been made concerning the effect of this treatment upon the viability of the seeds. In order to dispel any doubt in this direction the following table consisting of the results of a number of tests carried out during the last season is shown. The germinations before and after treatment with absolute alcohol, as well as the varieties treated, are given:—

Test Nos.	Variety.	Germination before Treatment.	Germination after Treatment.
1656-1657	Hickory Pryor	86	86
1736-1737	Bonanzo	80	86
1819-1820	Conqueror	71	71
1821-1822	Warne	73	69
1823-1824	Dungawan	62	72
1825-1826	Hickory Pryor	70	76
1827-1828	Hester	30	33
1829-1830	Spotted Gum	20	19
1831-1832	Hickory Pryor	88	80
1836-1837	Hickory Pryor	76	72
1938-1839	Hickory Pryor	76	74
1840-1841	Hickory Pryor	97	97
1844-1845	Hickory Pryor	60	56
1846-1847	Hickory Pryor	98	90
1848-1849	Hickory Pryor	76	74
1850-1851	Warne	62	60
	Average	70	70

Considering experimental error, the two columns show quite good agreement, thus demonstrating that the germinating power of the seed is not reduced if reasonable care is exercised.

The seeds should be dried as soon as possible after being taken from the alcohol, and if a radiator or any other heating apparatus is used during the drying operation, extreme care must be taken to prevent the tobacco seed from becoming excessively heated. Experiments which I have carried out with an electric incubator prove that any temperature above 40° C. (104° F.) which continues for an appreciable time is sufficient to destroy the viability of tobacco seed when moist.

Thus, it is evident from the above notes and disinfection work performed by the Plant Pathology Branch of this Department, that with reasonable care the germination of tobacco seed is not reduced by treatment with alcohol.

FEEDING WHEAT TO PIGS.

G. K. Baron-Hay, Superintendent of Dairying.

(Reprint.)

Enquiries are being received daily as to the profit likely to be derived from the feeding of wheat to pigs, and whether, with wheat alone available as a food, it is possible to rear pigs suitable for the bacon trade.

A visit to the metropolitan market at Midland Junction will convince the observer that many excellent bacon pigs are now being forwarded from wheat-growing areas, but it also will be obvious that large numbers are being incorrectly fed, with disappointing results to the owner when sold.

It is hoped that the following notes will be of value to those intending to market a portion of their crop of wheat in the form of pork or bacon.

MAKING A START.

While undoubtedly more profit is made from feeding pigs bred on the farm, this will be impossible in the initial stages, owing to the delay necessary for breeding and weaning the prospective bacon pigs.

A start will have to be made with store pigs, probably bought in the market.

The chief drawback to purchasing store pigs is the difficulty of obtaining a sufficient number of the right type and of even weights.

A long bodied pig, with long deep middle, heavy ham and a light shoulder is the type to purchase, and should be relatively lean, otherwise there may be a danger of fattening when too small.

The size of pig to buy for fattending will depend to a great extent on the cost of freight and cartage to and from market. The greater these costs the younger should store pigs be purchased, and fed to as heavy a weight as practicable, in order to spread this cost over as many bushels of feed wheat as possible.

There is a limit, however, to the weight at which young pigs may be purchased for feeding with wheat. Experience has shown that weaners cannot be purchased safely and reared on wheat as a basal ration. It is inadvisable to purchase pigs weighing less than 80 lbs. (live weight) for fattening purposes.

BREEDING.

The aim should be to breed one's own baconers as soon as possible. For this purpose good high grade sows of the Berkshire breed, or Berkshire-Tamworth cross, may be bought at almost any large pig sale to-day. These should show good length and depth, fine skin free from wrinkles. They should be fine in bone and have at least 12 well placed teats.

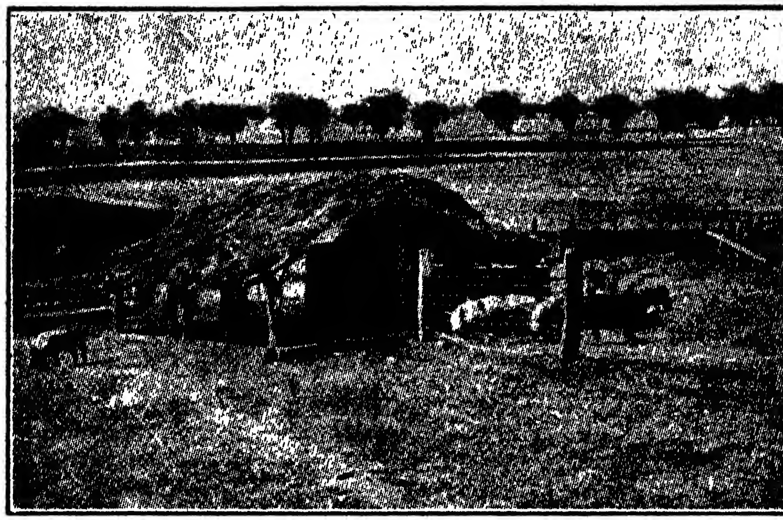
It is essential to obtain, from a reputable breeder, a pedigreed boar for mating with these sows, and if possible from a large litter. This boar should show all the essential points of a bacon pig (See article in "Journal of Agriculture," March, 1930—"The Bacon Pig," Bulletin 296.)

The pure bred Berkshire boar is recommended for general "grading-up" purposes.

SHELTER AND WATER SUPPLY.

On Wheat Belt areas it is essential that ample shade should be provided. Cheap temporary shelters may be made from saplings, the roof being of straw or boughs, and approximately 4 feet from the ground. These may be burned without serious loss, should they for any reason become foul.

A plentiful supply of clean water is also essential. The writer has in mind where a farmer lost several valuable sows through allowing them to drink water from a clay hole, the clay flocculating in the intestines, causing impaction. Water should be available from troughs only.



A cheap, effective shelter on a wheat farm.

FEEDING WHEAT.

Wheat alone is not a complete ration for growing pigs, being low in proteins for flesh building, and also lacking in mineral matter for skeleton formation. This deficiency may be made up in two ways:—

(1) By the addition of skim milk to the ration.

(2) By the addtion of meatmeal and bonemeal.

Skim Milk.—A large quantity of skim milk is not necessary to provide the protein required to form a complete ration. One gallon to each 4 lbs. of grain feed is sufficient, and also economises in grain.

Skim milk, if available, should be reserved for weaner pigs.

Meatmeal and Bonemeal.—Where skim milk is not obtainable, meatmeal must be fed in the proportion of approximately 8 per cent. of the grain ration. In addition, bonemeal should form 2 per cent. of the ration.

WHOLE OR CRUSHED WHEAT.

Wheat should be crushed or cracked before being fed, and provided this is carried out, there is no need to soak the wheat.

Uncrushed wheat, however, shows a loss as high as 20 per cent. over crushed wheat, through not being digested.

The cost of feeding can be considerably reduced by using self-feeders, allowing the pigs to have free acess to both wheat and meatmeal. It has been found in numerous feeding tests that self-feeders are economical in feeding, and that the pigs consume meatmeal at approximately 8 per cent. of the total grain consumption.

COST OF FEED CONSUMED.

The results of fifteen months' feeding on the Rutherglen Experiment Farm, Victoria, concluded last November, have shown that on the rations mentioned above, allowing the pigs to consume all they desire.

The average grain per pig per day = 1.35 lbs.

Feed per pig per day = 3.47 lbs. wheat and .28 lbs. meatmeal.

Feed per lb. gain in weight = 2.57 lbs. wheat and 20 lbs. meatmeal.

Pigs Pasturing.

The following table will indicate on these figures that the feeding of wheat to pigs, even at present prices of bacon, is profitable:

Pig purchased at 80 lbs., and fattened to 180 lbs. live weight.

	£	s.	d.
Purchase price 80 lb. pig (live weight) ..	1	5	0
Meatmeal consumed, 20 lbs. at 1.87d. ..	0	3	1½
Bonemeal, 4 lbs.	0	1	0
	£1	9	1½
Present day value	2	10	0
Value of wheat fed	£1	0	10½

or 4s. 11d. per bushel.

The net return will vary depending on the location of the farm from the market, but costs can be accurately worked out for any locality, using the above figures for food consumed.

BORDEAUX MIXTURE.*

THE MOST COMMONLY USED FUNGICIDE.

Simple Directions for its Preparation in either Small or Large Quantities.

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

Ever since the discovery by Millardet, in 1882, in the Bordeaux district of France, of the strong fungicidal (fungus-killing) properties of a mixture of lime and bluestone, the mixture known as "Bordeaux" has been the leading spray material all over the world wherever fungous diseases have had to be combated. This fortunate discovery was the result of Millardet's chance observation of the protective action of such a mixture against the dreaded "downy mildew" disease of the grape (*Plasmopara viticola*), where the grape vines near the roadside had been conspicuously treated to discourage the boys of the neighbourhood from stealing the fruit, by giving them the impression that the grapes had been poisoned.

Although to some extent superseded of late years by Lime-Sulphur, especially in cool climates, as a summer spray on apples and stone fruit, and by such other substances as "dry-mix sulphur-lime," "atomic sulphur," "sulphur dust," copper-lime dust," "copper carbonate-sulphur dust," etc., for certain diseases, it still remains ". . . . the most widely known and the most generally useful of all spray liquids employed against parasitic fungi" (1).

GOOD QUALITIES OF BORDEAUX MIXTURE.

The great and lasting popularity of Bordeaux Mixture as a spray for the vine, and for most orchard, vegetable, and flower-garden plants, may be attributed very largely to its following good qualities:—

1. When properly prepared, it is remarkably adhesive to most types of stems, fruits and foliage. After it has once dried on the plant it can only be slowly removed by rains, dews, or other climatic influences.

2. It has a very high efficiency in preventing infection of the above-ground parts of plants by most types of fungi.

3. The cost of the ingredients required to make a large volume of spray is relatively low.

4. When used at the ordinary strength, it is quite harmless to most types of cultivated plants.

5. It has a decidedly tonic effect on the growth of many plant species, quite apart from its fungicidal action.

6. It is quite simple to prepare and safe to handle.

DRAWBACKS TO THE USE OF BORDEAUX MIXTURE.

1. Its main disadvantage is that the bluestone (copper sulphate), which is one of the essential ingredients, will speedily corrode iron or steel and all the other commonly-used metals or alloys except copper, brass or bronze. This difficulty is

* Reprinted and revised from the article of the same name which appeared in the December issue of this "Journal" for 1930, pp. 600-609, owing to the leaflet embodying this information now being out of print.

usually overcome, in practice, by dissolving the bluestone in wooden tubs or casks, and by using bronze, brass, or porcelain-lined spraying equipment and accessories. On a small household scale the copper sulphate may be dissolved in copper, brass, bronze, glass or earthenware vessels.

2. Another disadvantage is that Bordeaux Mixture has been found very apt to cause injury to the leaves and fruit of apple and most kinds of stone-fruit trees (especially peaches and Japanese plums) if applied in the spring or summer *after* the "spur-bursting" or "bud-bursting" stage. To overcome this disability in the case of apples, only very weak strengths and an excess of lime are recommended from the "pinking" stage onwards, or weak "lime sulphur" may be substituted for the later sprays.

There is no difficulty in this State so far as Bordeaux injury to *stone fruits* is concerned, inasmuch as all the fungous diseases which occur here, as yet, on such plants, can be readily controlled by spraying with Bordeaux Mixture in the winter, or just as the buds are bursting in the spring, or, in addition, as the leaves are falling from the trees in the autumn, as the case may be. If these sprayings are carried out efficiently, there is, at present, no necessity for the summer spraying of stone fruits in this State.

Apricots are fairly resistant to Bordeaux injury and may be safely sprayed with the 3—4—50 strength when the fruit is well set to half-grown, if necessitated by the seriousness of "Shot-hole."

Bordeaux Mixture should only be applied during warm, dry weather, as injury is most likely to occur if the spray is used during, or just preceding, rainy or dull, humid, slow-drying climatic conditions. The addition of an efficient spreader (see section on spreaders near the end of this article) will also tend to lessen the danger of russetting the fruit or causing leaf injury. Further information *re* using Bordeaux Mixture as a spray for apples after the "spur-bursting" stage will be found on pages 254-263 of the June issue of this "Journal" for 1930, or on pages 17-23 of Department of Agriculture Bulletin No. 306, entitled "Black Spot or Scab of Apples and Pears in Western Australia."

3. The only remaining serious objection to the use of Bordeaux Mixture is that it imparts a bluish colouration to sprayed plants, so that it is sometimes considered unsightly on ornamental or flower-garden subjects, and it cannot, of course, be used on produce just prior to marketing. For this latter purpose, ammoniacal copper carbonate or very dilute Burgundy mixture (1-1¼-50) should be used instead. (Ammoniacal copper carbonate is made by mixing 5 ounces copper carbonate in a non-corrosible container with sufficient water to make a thick paste. Then add 3 pints strong ammonia—26° Beaumé—to dissolve the paste. Then add a little more copper carbonate with frequent stirring (up to about 1 oz.) till no more can be dissolved. Then dilute with water to make 50 gallons.)

4. Evidence is accumulating that Bordeaux Mixture may increase drought injury of certain plants grown under very dry conditions by increasing the transpiration ratio. Under such circumstances, however, fungal troubles should not be of sufficient importance to necessitate spraying

HOME PREPARATION OF BORDEAUX MIXTURE ADVISABLE.

Many farmers, orchardists, vignerons, vegetable-growers and home-gardeners in this State are under the erroneous impression that Bordeaux Mixture is difficult to prepare, and, in consequence, obtain their copper fungicide as a powder already mixed. Numerous experiments the world over have indicated that ready-made

so-called "Bordeaux" Mixtures are not as effective, or as adhesive, as the freshly-prepared, properly-made, home-made mixture. Considerable burning of fruit and foliage has sometimes followed the use of commercial "Bordeaux" powders in this State. Mason, in his "Spraying, Dusting and Fumigating of Plants" (3), writes, "Bordeaux Mixture is the one spray which, if used in any considerable quantities, should always be made on the farm, the commercial forms being of less value than the freshly-made products."

USE OF LIME ESSENTIAL FOR THE PREPARATION OF TRUE BORDEAUX SPRAYS.

As already indicated, Bordeaux Mixture takes its name from the district in France where it was first discovered. True Bordeaux Mixture is always made from bluestone and quick lime (or, alternatively, hydrated lime) in a manner more or less as given below. Owing to the fact that quick lime rapidly deteriorates when in contact with the air, its use in ready-made powders, which may be kept in store for long periods before being used, is a practical impossibility. Consequently in commercial powders washing soda is generally used. Such substances are not properly called "Bordeaux" mixtures, but should be known as "Burgundy" mixtures, after the area in France where the bluestone-soda formula was first used.

Burgundy mixtures are much more apt to "burn" plant tissues than true Bordeaux sprays. Whereas increasing the amount of lime in a Bordeaux Mixture decreases its likelihood of causing injury, increasing the amount of soda in a Burgundy mixture, above a certain point, rapidly increases its "burning" properties.

Burgundy mixture has now very largely gone out of use on account of its caustic properties, although it was formerly very much used in some parts of the world as a substitute for Bordeaux.

FORMULAE FOR MAKING BORDEAUX MIXTURE.

The formula in most general use, at the present time, for most vegetable, flower-garden and fruit plants, is that known as "4-4-50." This means 4 lbs. of bluestone and 4 lbs. of "freshly-burnt," "stone," or "quick" lime to every 50 gallons of the mixture. 4-4-40 (i.e., 1-1-10) is another commonly used formula.

The standard formula may be varied, so as to allow for a greater or less proportion of bluestone to lime, as experience indicates to be necessary for the control of a particular disease and the avoidance of spray injury to the species of plant concerned. Thus 6-6-40 is used in Western Australia for the "bud-bursting," "pre-blossoming" and "fruit set" sprayings of the vine against "Anthracnose" (*Gloeosporium ampelophagum*), but later sprayings, if required, are given at 6—6—50, and the writer considers 2—5—50 all that would be permissible or necessary here for the summer spraying of apples against "black spot," should that disease become at all widespread (see Department of Agriculture Bulletin No. 306).

THE FIRST FIGURE IN THE FORMULA MEANS LBS. OF BLUESTONE.

In all formulæ for the preparation of Bordeaux Mixture the first figure given is the number of pounds of bluestone, the second figure is the number of pounds of "freshly-burnt," "quick" or "stone," lime, and the final figure indicates the full number of gallons to which the mixture must be made up with water prior to spraying.

DIRECTIONS FOR PREPARING BORDEAUX MIXTURE IN SMALL QUANTITIES FOR HOME GARDENS.

A small quantity of Bordeaux Mixture of very nearly 4-4-50 formula (actually 4-4-48) can be prepared by taking:—

(1) 4 ozs. bluestone,

(2) 4 ozs. "freshly burnt," "stone," or "quick" lime,

and making up to a final volume of 3 gallons as indicated below:—

a. **Dissolve the 4 ozs. of bluestone in a wooden tub or wooden barrel, or a copper, bronze, brass, glass or earthenware vessel, using 1½ gallons of water.** The bluestone may be dissolved by suspending it overnight in the water in a piece of hessian, bagging or linen, from a stick placed across the mouth of the receptacle; or by heating the water and pouring it over the bluestone in the bottom of the receptacle, if the mixture is required in a hurry.

b. **Slake the 4 ozs. of quick-lime, which must be quite fresh and of good quality, in another container, by adding water a little at a time.** A small wooden cask is convenient, but, unlike the bluestone, an iron vessel such as a clean empty kerosene tin may be used in which to slake the lime. **When slaked, make up to 1½ gallons with water.** This suspension and partial solution of lime in water is known as "milk of lime."

c. **Pour the two liquids simultaneously through a copper, brass or bronze wire strainer into the spray outfit, or into a wooden or other non-corrosible container, and, after seeing that the volume is exactly three gallons, use immediately.**

An alternative method is to first strain the milk of lime into the spray outfit through a piece of bagging to remove any gritty particles or lumps which might clog the sprayer, and then pour in the bluestone solution, keeping the milk of lime well agitated while doing so. See that the final volume is correct and commence to spray immediately.

Fig. 1.—A type of knapsack sprayer suitable for use on small areas. Note the Spring Lever Tap (Trigger Grip Control) with which the spray can be released or stopped instantly. The liquid capacity is 3½ gallons. Such a machine can be obtained with a copper tank for spraying with Bordeaux Mixture, made of special brass alloy for spraying, in addition, with Lime Sulphur or similar sulphides, or with all parts lead-coated for spraying with acids such as Sulphuric Acid, as used for the control of "anthracnose" of grapes, etc.

(*After "Vermorel Eclair Export Catalogue,"* No. 22. 1932.)

The bluestone solution and the milk of lime can be kept indefinitely, so long as they are kept separate and any evaporated water is replaced to each before using; but once they have been added to each other the spraying must be commenced immediately and continued until all the spray is used up, as Bordeaux mixture soon deteriorates if left standing about after being made up.

Never mix the solid lime and bluestone together before adding the water. The more dilute each constituent is before meeting the other, the better.

STOCK SOLUTIONS AS A MEANS OF REMOVING THE DRUDGERY FROM THE FREQUENT PREPARATION OF BORDEAUX MIXTURE.

It rarely happens that a single spraying is sufficient to control a disease in plants. Even in those cases where a single spraying carried out at the right time does suffice, as with "Shot-hole" of stone fruits in many places, the orchardist usually finds that the different varieties are not all ready for spraying at the same time. This usually means that the spraying period is protracted and the grower becomes impatient at having to continually make up "from scratch" a fresh lot of spray. Frequently, also, a grower finds, on going to use his quicklime, that it has become air-slaked, with the result that a new lot of quicklime must be ordered for delivery in a hurry. This may cause fraying of tempers and there is always the possibility of a lot of damage being done by disease in the meantime, before the new lot arrives. A certain amount may be used out of the new consignment, and again deterioration may take place by the time the remainder is required.

Difficulties of the above nature may be readily avoided if the growers will appreciate the following facts:—

Although, when once prepared, Bordeaux Mixture must be used immediately, the separate ingredients, i.e., the bluestone and the lime, can be kept in concentrated form in water for very long periods without deterioration taking place, and ready for use at a moment's notice.

METHOD OF MAKING UP THE STOCK SOLUTIONS.

The procedure is as follows:—

1. **Work out approximately how much bluestone and lime will be required to carry out your spray programme.** (It usually takes about 2 gallons of liquid to spray a well-grown apple, stone-fruit or citrus tree in this State for the control of fungous diseases, and anything from 100 to 150 gallons to cover one acre of vegetable crops such as almost fully-grown potatoes. Various factors will tend, however, to vary the amount required, and the experienced grower will know best just how much he will need for a particular area or job.)

2. **Then dissolve the bluestone in water in wooden casks or other non-corrosible containers at the rate of 1 lb. to every gallon of water.**

This can best be done by suspending the bluestone over-night, in a sugar bag or cut-down chaff bag, from a stick placed across the mouth of the cask and so arranged that the bluestone is just beneath the surface of the water. If wanted in a hurry, the crystals can be fairly readily dissolved by pouring hot water over them at the rate of about 1 gallon of hot water to every 3 lbs. of bluestone.

3. **Slake the "freshly burnt," "stone" or "quick" lime in other containers at the same rate as the bluestone, i.e., so that each gallon of the concentrate contains in it one pound of quick-lime.** This is done by adding water, a little at a time, until all the lime is slaked, and then bringing the water level up to the required height in the containers. Iron vessels are quite suitable to make the lime concentrate in, but wooden casks are generally used.

The New South Wales Department of Agriculture has carried out a series of experiments and finds that **lime may be stored under water even for periods of twelve months. There is a slight decrease in the effective lime amounting to about ¾ per cent., but this decrease is so slight as to be negligible (4).**

Only a little of the lime actually goes into solution, the major portion eventually sinking to the bottom of the container.

To check evaporation, a few drops of lubricating oil (not spraying oil) may be placed on the surface of each concentrate and a mark should be made at the surface of each lot when it is finished with for the time being, so that any water which has evaporated may be replaced before using it again. Covers could also be placed over concentrates to prevent animals or children interfering with them, and they should be protected from rain, dust-storms, etc., when not in use.

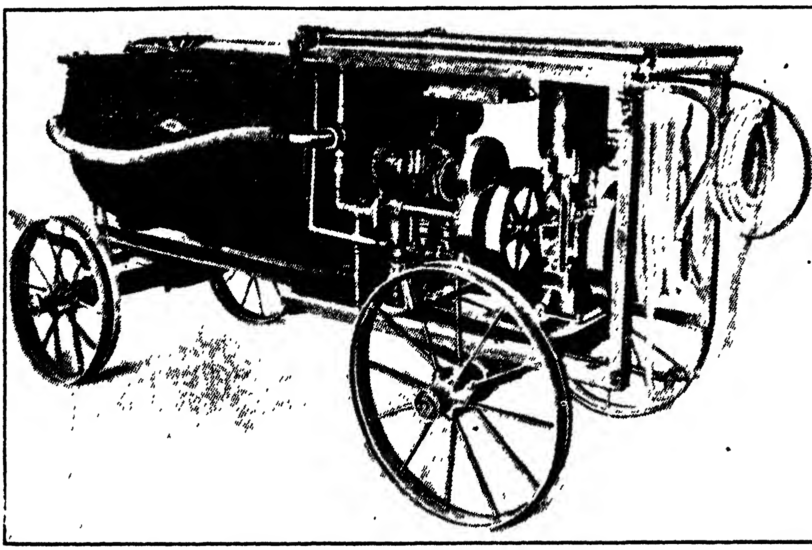


Fig 2.—A power sprayer of American make especially suitable for orchard work. The spray tank holds 200 gallons. The machine is drawn by two horses

(After W. J. Allen, in "Spraying"—"Farmers' Bulletin," No. 72, 2nd edit., N.S.W. Dept. Agric., June, 1915.)

PROCEDURE TO BE FOLLOWED WHEN MAKING THE BORDEAUX MIXTURE FROM THE CONCENTRATES.

There are two alternative methods which may be used for making the Bordeaux Mixture from the concentrates.

The first method is the simpler, but does not give quite as good a spray mixture as the second. The second method gives the best possible mixture, but involves the use of a little more equipment than the first.

FIRST METHOD.

a. **Stir the lime concentrate thoroughly, being especially particular at the sides and corners of the container, so as to get a uniform distribution of the lime in the water, and, when thoroughly well mixed, dip out the full amount required, remembering that, when well stirred, each gallon of lime concentrate contains the equivalent of one pound of quick-lime. Pour the lime into the spray tank through a piece of bagging, or, better still, a fine wire sieve containing 18-20 meshes to the inch, to remove any gritty or coarse particles which might tend to block up the spraying equipment.** (A copper, brass or bronze wire sieve is the best, as it can then also be used for the bluestone when the time comes.)

If 4 – 4 – 50 Bordeaux was being prepared, for example, and it was proposed to make 50 gallons, it is obvious that 4 gallons of lime concentrate would be required to be sieved into the spray tank. The lime requirement is always the second figure in the formula.

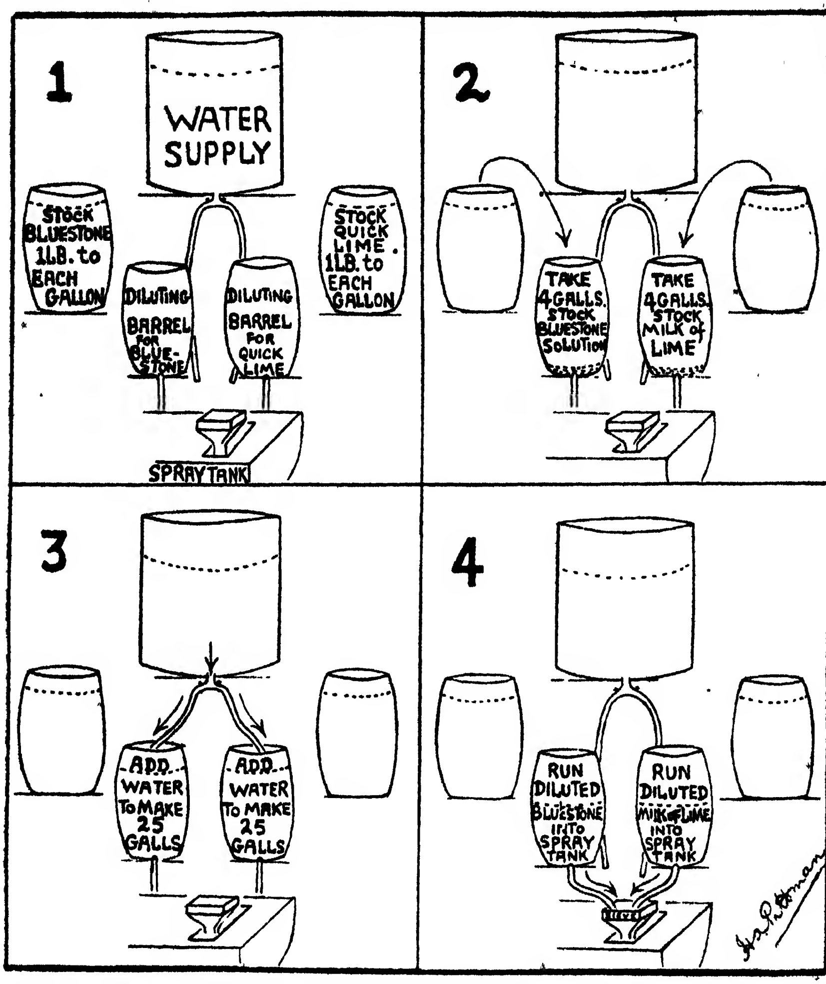


Fig 3.—Diagrammatic representation of method of preparing 4-4-50 Bordeaux Mixture from Stock Solutions of Bluestone and of Lime. The Stock Solution of Bluestone is made by dissolving 1 lb. of Bluestone to each gallon of water, and the Stock Solution of Quicklime by slaking, in a separate container, 1 lb. Quicklime for each gallon of "milk of lime" required, in the manner indicated in the text.

(1.) Apparatus and solutions ready for preparing the Bordeaux.

(2.) Four gallons of concentrated bluestone solution have been placed in one of the dilution barrels and four gallons of concentrated "milk of lime" in the other.

(3.) Water is added to each dilution barrel to bring the volume in each to 25 gallons.

(4.) The diluted bluestone and diluted lime are then run simultaneously into the spray tank through a brass, bronze, or copper wire strainer having 18-20 meshes to the linear inch. The agitator is kept running during this process.

(Drawing by Author. Not to scale and details of taps, etc., have been omitted.)

b. After sieving the lime concentrate into the spray tank, add water to the tank until it contains about three-quarters of the total volume of spray to be

made; i.e. in the specific case under consideration, fill up the tank to about 40 gallons.

c. Set the agitator going and strain in the required amount of bluestone concentrate, remembering again that each gallon of bluestone concentrate contains 1 lb. of solid bluestone.

For the 4 – 4 – 50 formula being discussed, then, we would need 4 gallons of bluestone concentrate to be sieved through the brass, copper or bronze sieve into the agitated and diluted lime in the spray tank. (There should really be no need to sieve the bluestone solution, except that small pieces of straw, etc., which might block up the sprayer, might have been blown into the solution during the storage period.

d. We have now arrived at the stage where about 43 gallons of liquid, containing a light-blue flocculent precipitate, are in the spray tank. **If a spreader is to be used, it should now be added, and then the volume should finally be brought up to 50 gallons with the necessary amount of water.**

SECOND METHOD: To be used, wherever possible, in preference to the first. (See Fig. 3.)

This method is preferable to the first, but necessitates two extra containers, The underlying principle is that the ideal Bordeaux Mixture can only be prepared if both the lime and bluestone concentrates are diluted as much as possible (i.e., in each case to half the total volume of the Bordeaux to be made) before running them together simultaneously through the brass, bronze or copper wire strainer into the spray tank.

In the case of the 4 – 4 – 50 formula under discussion, for example, 4 gallons of bluestone concentrate are diluted to 25 gallons, with water, in a second wooden barrel or other suitable container. Four gallons of lime concentrate are similarly diluted in a wooden or iron container to 25 gallons, and then both lots of the diluted materials are run together simultaneously through the non-corrosible sieve into the spray tank, by means of taps and rubber hoses let into the bottoms of the dilution vessels. (See Fig. 3.)

THE MIXTURE MUST BE USED IMMEDIATELY IT IS PREPARED.

Use the Bordeaux Mixture immediately, if possible, but if, for any unforeseen reason, it has to be kept standing for some time before use, first add to it one-eighth of an ounce of table sugar (cane-sugar) for every pound of bluestone which has been used. In the example being considered, ⅛ oz. x 4 = ½ oz. of table sugar would need to be used. The table sugar prevents the deterioration of the flocculent (flake-like) blue precipitate to which the Bordeaux Mixture owes its desirable qualities. (One heaping tablespoonful of table sugar equals one ounce.)

AN ELEVATED STAND VERY CONVENIENT.

For the most convenient preparation of Bordeaux Mixture a wooden stand should be erected handy to an overhead water tank or other source of water supply. The vessels to hold the concentrates and the diluted ingredients are placed on the stand, which is built of such a height that the tank on the spray outfit can be conveniently filled by the force of gravity. In this way all heavy lifting is obviated, the only liquids requiring to be lifted being the small quantities of concentrates

required for every 50 gallons of mixture. Instead of a wooden stand a vertical cut through a hillside or earth bank may be made to allow the spray equipment to pull up in front of, but below the level of, the mixing site.

Fig. 4.—A good type of elevated stand for the preparation of Bordeaux Mixture and the convenient filling of the spray outfit. Stock solutions may be diluted in the two central barrels on the lower platform, and run into the spray tank through a large pipe and hose extending out from between the barrels. The stock solutions of copper sulphate (bluestone) and lime may be kept in other barrels on the lower platform, or in two large barrels on the top platform. It is better if the top platform is reserved for the water supply, which may be held in large barrels or an iron tank. If an iron tank (galvanised or otherwise) is used to hold the water supply, care should be taken that it is not splashed with the bluestone solution, or, better still, it should be well protected on the outside with good quality paint or tar to prevent corrosion.

(After Mason, "Spraying, Dusting and Fumigating of Plants.")

PURITY OF THE INGREDIENTS ESSENTIAL.

The bluestone bought should be of at least 98 per cent. purity. It should be in the form of large dark-blue crystals, and should not contain any appreciable amount of the greenish-coloured sulphate of iron which is sometimes met with in commercial samples of bluestone. It may be tested by dissolving a small quantity in water, diluting this with extra water in a tumbler until it becomes a light-blue colour, adding a little ammonia and then stirring well. A pale-blue precipitate of copper hydrate is first formed, but this quickly dissolves, if enough ammonia is present, to give a very intense violet-blue colour. The formation of a reddish-coloured precipitate or sediment indicates the presence of iron.

THE LIME MUST BE FRESHLY BURNT.

With reference to the lime used for the preparation of Bordeaux Mixture, it is of extreme importance that the lime should be freshly burnt. To test whether this is so, or to see if it has become to any extent water- or air-slaked, a few lumps should be placed in a heap and sprinkled with water. Freshly-burnt lime will become very hot, give off a quantity of steam, gradually fall to pieces and crumble to a fine white powder. Some lime will not do this readily with cold water, but may do so if hot water is used. If the lime does not get hot enough to give off steam, even with hot water, it is unsuitable.

Water-slaked lime may be used, provided that it has only been slaked a day or two at the most, and that the correct adjustment is made to the formula. If using fresh water-slaked lime, increase the lime content of the formula by one-third to one-half extra. Air-slaked lime cannot be used under any circumstances.

In practice the best procedure is to very definitely specify "freshly-burnt" lime when ordering, and then to slake it immediately on its arrival and keep it under water until required, as described in a preceding section of this article.

Fig. 5.—Desirable type of power-sprayer for large orchard Note the sturdy steel frame, underslung tank, large wide tyred rear wheels and small front wheels which will run under the frame, making short turns possible. There is sufficient capacity to operate two spray "guns" at high pressure.

(*After Mason, "Spraying, Dusting and Fumigating of Plants"*)

TESTS FOR BORDEAUX MIXTURE.

Bordeaux Mixture is said to owe its valuable fungicidal properties to a basic copper sulphate from which the ordinary copper sulphate is reformed in very small quantities from time to time. These quantities are too small to harm the tissues of most plants, but are yet quite sufficient to kill the germinating seed bodies

(*spores*) of harmful fungi. If, by some mischance, there should happen to be too little lime in the Bordeaux Mixture to completely turn the bluestone into the insoluble basic sulphate, considerable injury could be caused to any plants sprayed. While there should be very little likelihood of this happening if ordinary care is taken, each lot of Bordeaux Mixture made up should be tested, before using, in one or other of the following ways:—

A. Take a little of the Bordeaux Mixture in a glass vessel, add a few drops of acetic acid, and then add a few drops of a solution of ferrocyanide of potassium in water. (The strength of the ferrocyanide should be 4 ozs. in one pint of water. Both the ferrocyanide and the acetic acid are obtainable from any chemist.) Should any brown discolouration occur, the Bordeaux Mixture does not contain enough lime, and more lime concentrate must be added, until, on further testing, no discolouration is apparent.

B. A rough but useful test which can be made to see if the Bordeaux contains enough lime to neutralise the bluestone, is to dip the clean blade of a penknife, or a bright piece of iron such as a roughened-up shiny nail into the mixture for several minutes. If the mixture does not contain sufficient lime, a reddish-brown deposit of copper will form on the iron and more lime should be added. *Always use a little too much lime rather than a little too little*, as quite a considerable excess of lime may be used without the fungicidal properties of the spray being markedly lowered.

Fig. 6.—Spray boom of excellent type, showing the arrangement of nozzles to ensure thorough covering of such crops as potatoes, tomatoes, beans or similar plants grown in rows.

(After Mason, "Spraying, Dusting and Fumigating of Plants.")

THE USE OF SPREADERS WITH BORDEAUX MIXTURE.

Whenever Bordeaux Mixture is used, the spreading, wetting, and adhesive qualities of the spray will be very greatly improved by the incorporation of a special spray "spreader" or "sticker." In addition, the spray, on drying, will

settle down into a very thin, well-distributed and more or less continuous layer, rather than into a number of scattered spots. The fungicide will therefore prove more efficient with a "spreader" than without, as, where the spray dries up in spots, very little, if any, protection is afforded to the tissues in between. Where spreaders are used there is also very much less danger of damaging the leaves or fruit, for the reason that the concentration of the solid materials from the spray is never so intense at any one point as if no spreader is used. Moreover less spray is used as there is not such a tendency to hold the spray nozzles for some time in the one place to try and *force* the material to wet the tissues and stay on.

CALCIUM CASEINATE SPREADER.

The following substances are some of those which have been used from time to time as spreaders or stickers, in various sprays: oils, resins, soaps, glue, milk and molasses, but *calcium caseinate,* a by-product obtained from skim milk, is the only one which has become very popular or widely used.

Calcium caseinate should be used at the rate of one half to one pound (½—1 lb.) per 50 gallons of spray. In mixing, make the required amount of calcium caseinate into a paste in a billycan, jug, or other suitable receptacle, by putting the caseinate into the dry container and then adding as much water by volume as there is caseinate. Stir, so as to form a thin paste (just in the same way as powdered skim milk is mixed by the experienced housewife for human use) and, when made into a paste, dilute with water and add to the mixture in the spray tank, keeping the agitator going during the process.

SPREADERS FOR BORDEAUX MIXTURE OTHER THAN CALCIUM CASEINATE.

If calcium caseinate is not obtainable, one or other of the following substances may be used instead:—

1. A good brand of *commercial powdered skim milk,* used at the rate of ½—1 lb. for every 50 gallons as indicated above for calcium caseinate.

2. *Sweet skim milk,* used at the rate of half a gallon to every 50 gallons of spray.

3. *Flour,* used at the rate of ½—1 lb. to every 50 gallons of spray. Mix with water to a thin paste and then add to the mixture in the spray tank.

4. *Glue,* ½ oz. to every 50 gallons of spray. Dissolve in hot water and then add to the mixture in the spray tank.

5. *Good quality soft soap,* 2—3 lbs. per 50 gallons of spray. Dissolve in water and add to the spray mixture in the spray tank, or barrel, *only just before the spray is to be used.*

6. *"Resin-Fish Oil" Soap,* 2—3 lbs. per 50 gallons of spray. Dissolve in water and add to the spray mixture in the spray tank, or barrel, *only just before the spray is to be used.*

"Resin-Fish Oil" Soap is especially valuable as a sticker and spreader in Bordeaux Mixture for spraying smooth-leaved plants such as cabbages, onions, carnations, etc.

7. For spraying citrus trees or other plants which are not injured by white spraying oils, ½ to 1 gallon of such oil may be used as a spreader in every 50 gallons of spray.

Another advantage in the case of citrus is that the use of the oil acts as a check on scale insects which otherwise are very apt to increase to serious proportions following Bordeaux sprayings, unless only the lower half or two-thirds of the tree is sprayed. (See Leaflet 354 on "Brown Rot of Citrus and Its Control.")

In using any spray spreader it is advisable not to make the spray liquid in the spray tank, or barrel, up to the full volume until *after* the spreader has been added, so that the strength of the fungicide will always be as much as possible the same whenever it is made up to the same formula. In other words, if making up a 4—4—50 Bordeaux, the *final* volume of spray after the spreader has been added, should be just 50 gallons. A mental attitude of exactness should be maintained all through the operations of preparing the Bordeaux Mixture. Carelessness or "slip-shod" methods in weighing out or preparing the materials, or in any other part of the operations, cannot be too strongly deplored.

FINAL NOTE.

Finally it should be pointed out that before using the spray apparatus, especially after it has been idle for any length of time, it should be thoroughly washed out to remove any chemicals which may have been left from the previous spraying. This is exceedingly important when the spray being used is a different kind from that previously employed, as, according to Cunningham (2), this mixing of different spray materials in the tank is one of the most frequent causes of spraying injury to plant tissues.

BORDEAUX PASTE.

It is very desirable, after removing large branches from trees, or after cutting out diseased tissues from the trunk or root system where some such disease as Armillaria or Collar Rot is being dealt with, to paint the wound with some antiseptic material which will prevent invasion of the wound before it heals over.

Bordeaux Paste is one of the best materials which may be used for this purpose, or for painting over the wounds made in grafting, after the scion has been inserted and before the grafting wax is applied.

Various formulae are used such as 1½—3—2, 1—2—1½, or 1½—4—1½.

For making up Bordeaux paste according to the first formula (1½—3—2) take 1½ lbs. of bluestone, 3 lbs. quicklime, and 2 gallons of water.

Dissolve the 1½ lbs. bluestone in half the water, *i.e.*, 1 gallon. Slake the 3 lbs. of quicklime with the other gallon of water. Then pour together and stir thoroughly before using. Apply with a brush as soon after the wound is made as possible.

When not in use the mixture should be kept in a closed container.

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(3) Mason, A. F.—"Spraying, Dusting and Fumigating of Plants." Macmillan Co., New York, 1929.

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"THE JOURNAL OF AGRICULTURE"

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SUCKLING CLOVER

(*Trifolium dubium*, Sibth.).

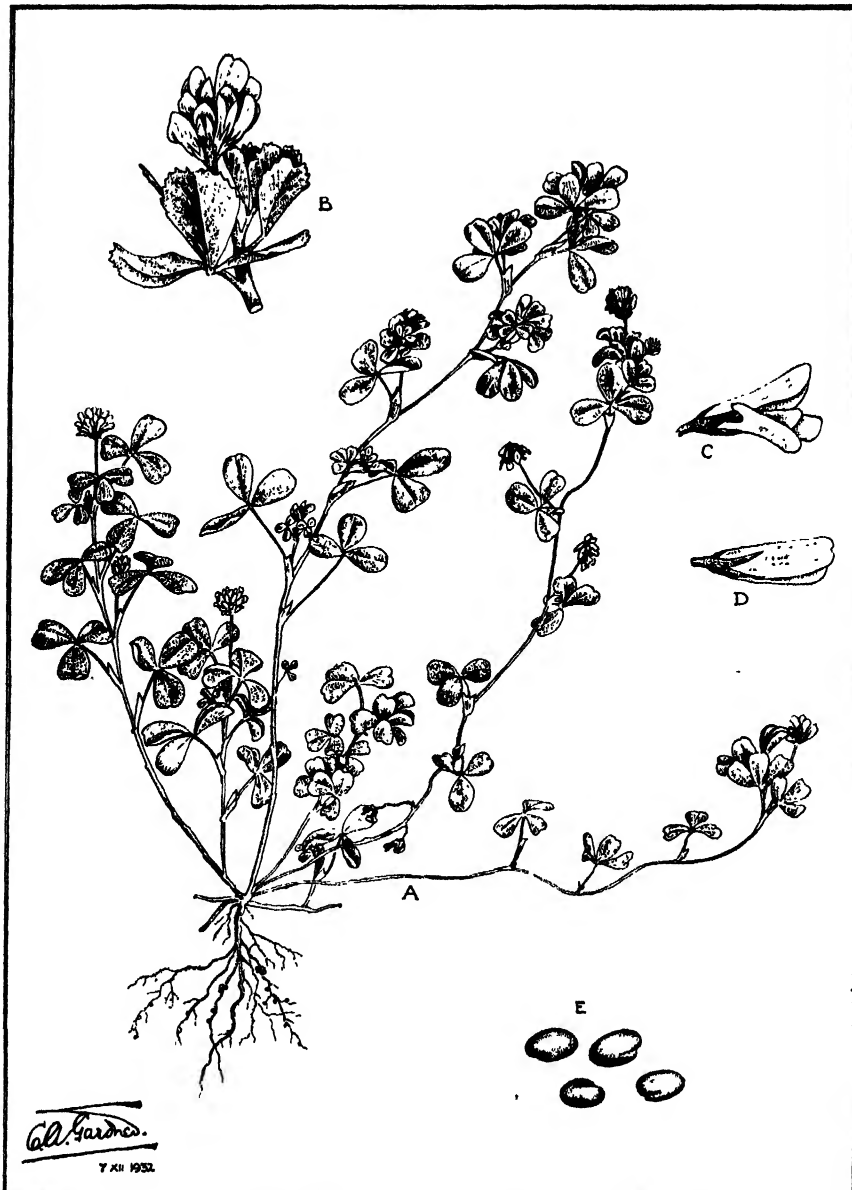
C. A. Gardner,
Government Botanist.

Suckling Clover, or Yellow Suckling Clover, is one of the minor annual clovers of our pastures. Originally planted on a fairly extensive scale in the more primitive pastures of the South-West, the plant has become firmly established there, and is now a more or less common constituent of the majority of pastures.

The clover is a small yellow-flowered plant which, if given space in which to develop, assumes a more or less creeping habit like that of Hop Clover, but is smaller in all its parts and more densely foliaged, extending to a diameter of from 6-9 inches. Under conditions of dense growth or root competition it grows erect, and may be as high as 12 or 16 inches, but is correspondingly decreased in width.

Suckling clover is commonly seen in the South-West, either as a naturalised plant almost anywhere where clearing has taken place, or growing with the various pasture plants, especially in the low-lying or moister situations, usually with Drooping-flowered clover and Subterranean Clover. It can always be distinguished from the major clovers by reason of its yellow flowers; from *T. filiforme* it can be readily distinguished by the number of flowers in the head—5-15 (*T. filiforme* has 2-5)—and from Hop Clover by its smaller flowers and standard being not grooved.

Although a palatable clover, Suckling Clover is not worthy of cultivation in the clover lands of the South-West. It is too small to provide any considerable bulk of feed, and occupies space that would be better devoted to more valuable



Suckling Clover.

plants. In permanent pasture it is to be regarded as a weed, and where more valuable clovers flourish it remains an undesirable constituent of pastures.

For the lighter rainfall areas, however, it has a decided value. It is a much superior plant to Woolly Clover, Hop Clover and Narrow-leaved Clover, and appears to be capable of thriving on more or less acid soils. The clover would be valuable in areas where the rainfall is between 18 and 14 inches. In lower rainfall areas its success would be doubtful. Where it will thrive under the drier conditions it must be regarded as a valuable clover and one which enriches the soil.

Although a common and troublesome winter weed of lawns, it can be safely recommended for golf course fairways, providing a dense mat of herbage which will withstand rough treatment, making a good soil-binder during the spring, and its low habit of growth further recommends it for this purpose. The rooting system is strong and well developed.

Samples received for testing during the last nine years give the following results:—

Purity—84.6 per cent.
Germination—60 per cent.
Hard seeds—27 per cent.

Commercial lines of suckling clover usually contain some of the following impurities:—

Cluster Clover, Yorkshire Fog, *Amaranthus retroflexus*, Chickweed (*Cerastium vulgatum*), Rib grass (*Plantago lanceolata*), Sorrel (*Rumex acetosella*), French Catchfly (*Silene gallica*), and Chickweed (*Stellaria media*).

On the other hand, Suckling Clover is a common impurity in the following lines of seeds:—

Yorkshire Fog, Prairie Grass, Rye grasses, Lucerne and almost all clovers, especially White Clover.

The seeds are small, yellow, oblong-elliptical, smooth and shining, with a prominent radicle.

THE GRADING OF TOBACCO LEAF.

A. R. C. Clifton, Officer in Charge of Irrigation.
E. T. Morgan, Officer in Charge Potato Branch.

The publis taste is the prime factor in determining the value of tobacco and governs the price paid by the buyer to the grower of tobacco for his leaf. At present, a very high percentage of the tobacco consumed is used in the making of cigarettes, though formerly most of the tobacco produced was used by pipe smokers. The ideal tobacco for the manufacture of cigarettes is that from bright lemon-coloured, fine textured leaves, with desirable smoking qualities. It is generally found that the lighter the colour the milder the leaf and that it is more difficult to produce bright lemon-coloured leaf than the darker grades. For this reason buyers for the tobacco firms are much more interested in this "light" coloured tobacco than in the "dark." These buyers value leaf according to its aroma, texture, and whether its colour is approaching lemon yellow or not. The grading of tobacco leaf into the grades required by the buyers is unfortunately not receiving sufficient attention by the growers in general. Those growers, however, who are attending to this matter, are obtaining higher prices than those offering ungraded leaf. It has been estimated that grading makes a difference of 3d. per lb. in the price. The difference may be greater than this, for the buyer has no means of determining the quantities of the different grades and therefore will buy safely.

Ungraded leaf has to be graded in the factory and, therefore, the cost of this work will be allowed for in the price paid between the buyers and sellers in their transactions. However, there is little prospect of any ungraded leaf being sold in the future, and, therefore, growers must grade their leaf before offering it for sale.

Care and attention in this work will be repaid as buyers are more favourably disposed to handle a carefully graded crop.

GRADING.

This commences at harvesting by roughly sorting the longs and shorts, and the sound and damaged leaf when stringing on, the different grades being kept separate in the barn and in the bulk. When the crop is uneven, this work can be simplified by detailing certain pickers to gather leaf from a particular part of the stalk and each picker's leaf should be kept separate. The reason for this is that the texture of the leaf from each plant varies according to its position on the stalk, and it frequently happens that as the subsequent cures are being put through, it is likely that first, second, and third primings have to go into the same cure.

If this is done the grading is largely a matter of sorting according to colour and size. Though exact differentiation of colour requires practical experience, yet the tobacco grower could easily grade his leaf according to the chart submitted below.

Classes of Leaf.	Colour.	Size.	Grades.
1 Lugs—(leaves near the ground)	Lemon ...	Short ...	1 and
	Orange		
	Mahogany ...	Medium ...	2
	Dark		
2 Cutters—(thin elastic leaf)	Lemon ...	Short ...	1 and
	Orange	Medium	
	Mahogany ...	Long ...	2
3 Fillers and wrappers—(medium to heavy leaf)	Lemon ...	Short ...	1 and
	Orange	Medium	
	Mahogany ...	Long ...	2
	Dark		
4 Nondescript—(green, badly sunburnt, etc.)			

Small growers, of course, would not be able to grade their leaf into as many grades as indicated by the chart, but none the less they should endeavour to follow this table as closely as possible, and at least grade their crop according to colour and size.

Since colour is of such importance in the grading of the leaf, adequate lighting must be given in the grading shed. Each worker should, if possible, be allotted a portion of the bench to himself. In front of him should be bins or trays in which to place the leaf as he classifies it. It is not easy to determine colour in either direct sunlight or by artificial light, and the lighting should be so arranged that the shadow of the grader does not fall on the leaf. The best type of lighting is either from overhead skylights or from a series of windows in front of the grader over the bench. These should not face either in an Easterly or a Westerly direction. During the grading of the leaf the graders should separate and grade separately all leaf which is very short or nondescript and that which is too green. For obvious reasons, too, the best leaf is that which has the smallest proportion of rib and vein to leaf surface, and is fine-bodied with a fair degree of toughness and elasticity. The usual method employed is to bring several "sticks" of leaf on the bench, then after removing the strings, the leaf is left lying in one direction. Care, of course, is to be taken that leaf it not left hanging longer than is necessary or

that it is unduly exposed to light, since under such conditions it loses sheen and colour. Attention must also be paid to the moisture content of the leaf, that it is neither too moist or yet too dry. In the former case, when made up into "hands," it may become affected with mould and, in the latter, of course, it becomes too brittle to be handled.

When grading tobacco one should always remember that if the colour is doubtful at all, the leaf should be placed in the next lower grade, *taking care to keep out any leaf showing green colour*, which should be handled separately.

After the leaf has been graded, it is made up into "hands." These are made up by taking a number of leaves--usually 12 to 15 or more, according to size--and placing them with the butts all pointing in one direction. These are encircled by the thumb and forefinger and held together by wrapping the butts with a smaller leaf of similar grade. This smaller leaf or tie, *which must be of the same colour as the hand,* is folded back along the mid-rib so that the topside of the leaf is exposed. The tie-leaf is then wrapped round the hand, commencing with the tip and finishing with the butt end, the latter being held in position by tacking it between the leaves of the finished hand. A better job of the hand can be made by placing the tie over the end of the butts and then wrapping it around. The finished tie should be from 1½-2in. in width, according to the length of the leaves in the hand. The hand should have a diameter of approximately 1 inch, so that when completed with the tie-leaf, the circumference of the butt of the "hand" will be about 3½ inches. The length of the leaves in each hand should be approximately the same. The hands should be in such a condition that when the leaves are squeezed together, they will separate themselves on being lightly shaken.

RELATIVE FOOD VALUES.

L. C. SNOOK.

Agricultural Adviser, Dairy Branch.

For the benefit of those farmers who find it necessary to purchase concentrated foodstuffs for their dairy cattle, a table has been prepared, showing the relative values of common supplements at current market rates:—

RELATIVE VALUES OF CONCENTRATES FOR DAIRY CATTLE.

DECEMBER, 1932.

Foodstuff.	Cost.	Cost per 100 lbs.	Starch equivalent per 100 lbs.	Digestible Protein per 100 lbs.	Cost per lb. of Starch equivalent.	Cost per lb. of Digestible Protein
		s. d.			d.	d.
Wheat ...	3s. per bushel of 60 lbs.	5 0	72	9·0	0·83	6·7
Oats ...	1s. 9d. per bushel of 40 lbs.	4 4½	60	7·0	0 88	7·5
Bran ...	£5 17s. 6d. per ton	5 3	50	9 0	1·26	7·0
Linseed Meal	14s. 6d. per 100lbs.	14 6	76	26 0	2·29	6·7
Meat-meal ...	7s. 9d. per bag of 50 lbs.	15 6	90	60·0	2·07	3·1
Peas ...	5s. per bushel of 60 lbs.	8 4	72	17·0	1·19	9·5

Most dairymen have to contend with a protein shortage during the summer months, and if the yield of the milch cows is to be maintained some type of protein supplement must be fed. Linseed-meal has proved very popular for this purpose, but its use is often restricted for financial reasons. Fortunately, it appears that a much cheaper, and in many ways preferable, source of protein is available in the form of meat-meal.

Meat-meal is not generally considered as a food for dairy cows, but there is no apparent reason why it should not prove very successful as such. According to the table, meat-meal is by far the cheapest source of protein on the market, costing less than half as much per unit as the next cheapest. It is manufactured in our own State and is sterilised during its preparation. Meat-meal is a very concentrated food, and it would only be necessary to add relatively small amounts to the ration, hence no problem of palatability should arise. Meat-meal is rich in mineral matter, particularly phosphorus, and also contains lime, of which much is required by dairy cows. As far as one can gauge without undertaking an actual feeding trial, meat-meal should prove an excellent addition to the ration of lactating and growing livestock.

The cheapness of wheat as a food should also be noted. Wheat is as cheap a source of protein as linseed-meal and also supplies much cheap energy-producing material, but, being not so concentrated, is unsuitable as a sole source of protein. Elsewhere in this Journal will be found an article dealing with wheat as a food for dairy cows. This should be carefully perused, as full advantage of the low price of wheat should be taken by stock-owners.

Peas have been included in this table to indicate their value as a protein-rich foodstuff. Every farmer should endeavour to grow several acres of field peas for conservation as a cheap supplement to use during the summer months.

IMPORTANCE OF CAREFUL SELECTION OF RAMS AND EWES FOR LAMB BREEDING.

H. McCALLUM, Sheep and Wool Inspector.

The Fat Lamb Industry has brought into prominence certain of the British breeds of sheep. Many of these have been bred locally or imported from the Eastern States, and in most instances the quality reflects great credit on the breeders and has enabled a very solid foundation to be laid in the lamb breeding industry. The keen demand for sheep of these breeds, has, however, permitted a serious menace to creep into the industry. Some unscrupulous dealers have purchased animals of doubtful pedigree, or culls from good flocks, and disposed of them locally. With such sheep, especially as sires for a flock, the breeder will never achieve his objective, for they are weak in constitution and usually lack the main characteristics of the particular breed, therefore, their use will do untold harm to the industry. It is imperative, therefore, that when buying sheep for lamb breeding every care be taken to ensure that the animals are bred true to type and have the guarantee of the breeder. An offer of a very cheap lot should be regarded with caution; better to commence on a small scale with a few good sheep than buy up a large number of inferior animals.

The selection of the ewes to mate with the British breeds of rams is another very important factor to success in lamb breeding. The indiscriminate use of a flock of farm ewes cannot be expected to produce the uniform line of lambs so

desirable for the market. A prospective breeder should first decide on what lines he will work, then make arrangements to have his rams delivered when required, and then go through his ewes and select the largest framed, strongest constitutioned of them, paying due regard to uniformity, trueness to type, and general conformation; ill-nourished, badly-shaped, and under-sized mothers cannot be expected to produce lambs that will market in a prime condition. The progeny of badly selected breeding stock is to be seen at almost every sale, and their presence has a very detrimental effect on the prices. It costs no more to rear a first-class lamb than an inferior one, and this fact must be borne in mind by all breeders.

The lamb from ewes selected with due regard to constitution, conformation, vitality, fertility and trueness of type, mated to selected pure-bred sires, shows up in strong contrast to the animal bred haphazardly, when in the market pen, and meets with a very ready sale at a good price.

Feeding, of course, also plays its part in making a success of the venture, and all breeders must realise that it is essential to provide reserves so that the ewes can be kept in good condition prior to lambing and right up till the time the lamb is marketed. The slightest set-back in development greatly retards the maturity of the lamb, with consequent effect on prices received.

The sheep committee of the Royal Agricultural Society in deciding to reject all animals not up to standard at the show sales took a big step in the right direction, and breeders now have the assurance that all stock offered at these sales can be purchased with a guarantee as to their quality.

There are many breeders of the British breeds of sheep in Western Australia, and those embarking in the industry can purchase high grade breeding stock locally at very fair prices. Sometimes the price asked may seem higher than stock are offering in the markets, but the fact that the stud breeder has had to import and purchase his stock at very high prices, and carefully select his flock, must not be lost sight of, for lamb breeders are also purchasing, though perhaps indirectly, the results of his experience.

To prepare good pastures and water supply, select suitable ewes, purchase high grade pure-bred sires, feed all stock well, and handle carefully should be the practice of every lamb breeder who wishes to achieve success.

MARKET REPORT.

Messrs. H. J. Wigmore & Co. Ltd., of Wellington Street, Perth, have supplied us with the following information regarding the Chaff available for auction at the Perth Railway Yards, for the period September to November inclusive.

September.—675 tons of Chaff: F.a.q. to prime Wheaten Chaff was making from £4 2s. 6d. to £4 5s.; f.a.q. from £3 15s. to £3 17s. 6d. per ton. Medium quality was selling at from £3 7s. 6d. to £3 10s. per ton. Prime Oaten Chaff was finding buyers at auction and to arrive, at from £4 2s. 6d. to £4 5s. per ton; f.a.q. from £3 12s. 6d. to £3 15s.

Oats: Good heavy feed Guyras, Algerians and Mulgas were selling at from 1s. 10d. to 2s.; good feeds from 1s. 7d. to 1s. 8d. per bushel. Owing to short supplies of good heavy feeds towards the end of the month, the market firmed from 2s. 1d. to 2s. 4d. per bushel.

Wheat: F.a.q. was changing hands at from 3s. 4d. to 3s. 6½d.; second-grade from 3s. 1d. to 3s. 3d. per bushel.

October—835 tons of Chaff: At the beginning of the month the market for f.a.q. to prime Wheaten Chaff remained at £4 5s., and towards the end of the month eased to £4 per ton. F.a.q. found buyers at £3 15s.; medium quality from £3 5s. to £3 7s. 6d. per ton. Best samples of Oaten Chaff realised from £3 17s. 6d. to £4 2s. 6d., several consignments of well cut Oaten Chaff made up to £4 5s. per ton. F.a.q. was realising from £3 12s. 6d. to £3 15s.

Oats: Good heavy feeds were making from 2s. 1d. to 2s. 4d., good feeds from 1s. 9d. to 2s. per bushel.

Wheat: F.a.q. was selling at from 3s. 1d. to 3s. 5½d.; second-grade from 2s. 11d. to 3s. 0½d. per bushel.

November—795 tons of Chaff: F.a.q. to prime new season's Wheaten Chaff was finding its way on to the Perth market, and selling at £4; old season's at £4 2s. 6d. per ton. F.a.q. both old and new season's found buyers at £3 15s. Prime new season's Oaten Chaff was realising from £4 to £4 2s. 6d.; f.a.q. at from £3 15s. to £3 17s. 6d. per ton.

Oats: New season's Oats commenced to find their way on to the Perth market, and good heavy feeds were sold at from 1s. 10d. to 2s. 3d.; good feeds from 1s. 8d. to 2s.; light feeds from 1s. 4d. to 1s. 6d. per bushel.

Wheat: At the beginning of the month f.a.q. realised 3s. 8½d.; but towards the end of the month new season's wheat was finding its way on to the Perth market, and prices eased to 3s. 1½d. per bushel.

H. J. Wigmore & Co. Ltd., hold auction sales in the Perth Railway Yards, each morning, for Chaff, Grain and Potatoes, and all consignments forwarded to their care receive their best and prompt attention. The highest market prices with prompt returns are guaranteed.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF SEPTEMBER, OCTOBER AND NOVEMBER, 1932.

	SEPTEMBER.				OCTOBER.				NOVEMBER.				
	7.	14.	21.	28.	4.	12.	19.	26.	2.	9.	16.	23.	30
Sheep	14,736	13,089	12,706	12,198	11,547	15,257	15,160	12,744	12,173	17,046	15,585	12,518	12,803
Cattle	649	520	575	294	276	436	393	456	473	516	448	597	603
Pigs ...	1,387	1,533	1,291	2,017	987	1,855	2,105	1,846	1,244	1,497	1,059	1,419	879

COMPARATIVE VALUES PER POUND.

Mutton	4¾d	4¾d.	4¾d.	4¾d.	4¾d.	3½d	*2½d.	2½d.	2½d.	2¼d.	2¼d.	2¼d.	2¼d.
Beef ...	5d.	5¼d.	4¾d.	5¼d.	5¼d.	5¾d.	5½d.	5½d.	5¼d.	5d.	5d.	5d.	5d.
Pork ...	4½d	4¾d.	5d.	5¼d.	5¼d.	5¼d.	5¼d.	5d.	5d.	5d.	5d.	5d.	5¾d.
Bacon	5¼d.	5¼d.	5¼d.	5¼d.	5d.	5d.	5d.	5d.	5d.	4¾d.	4¾d.	4¾d.	4¾d.

* Shorn.

METEOROLOGICAL INFORMATION.

STATIONS.	September. Temperature. Maximum. Mean.	Highest.	Minimum. Mean.	Lowest.	Rainfall. For Month	Average.	October. Temperature. Maximum. Mean.	Highest.	Minimum. Mean.	Lowest.	Rainfall. For Month	Average.	November. Temperature. Maximum. Mean.	Highest.	Minimum. Mean.	Lowest.	Rainfall. For Month	Average.
					inches	inches.					inches	inches					inches.	inches.
Chapman State Farm	70·6	81·6	44·8	39·1	1·12	1·64	77·9	91·5	53·7	42·4	1·44	0·96	82·4	101·4	55·3	48·3	0·03	0·32
Geraldton	70·4	83·2	51·1	40·6	0·91	1·38	75·1	92·2	55·4	44·1	1·34	0·70	...	...	...	...	*Nil*	0·26
Walebing	68·2	81·3	43·4	33·1	1·08	2·19	72·4	92·3	48·9	37·5	2·65	1·34	82·6	104·6	52·9	43·3	0·03	0·53
Perth	67·8	82·2	49·6	39·1	1·58	3·49	70·1	87·8	52·8	43·1	3·43	2·16	75·2	95·4	56·9	49·0	0·13	0·79
Kalamunda	65·9	77·0	47·5	38·1	2·38	4·82	70·4	84·0	49·2	41·0	3·48	3·10	76·5	95·1	54·3	46·5	0·36	1·02
Bunbury ...	65·0	74·5	47·2	37·2	1·03	3·69	68·2	77·0	49·2	43·0	1·72	2·42	72·1	86·0	52·5	44·0	0·44	1·00
Bridgetown ...	68·0	82·0	41·2	31·5	2·39	4·00	71·4	88·2	43·4	31·2	1·53	3·00	77·1	95·0	47·6	36·2	0·44	1·14
Albany	64·1	78·4	48·1	40·1	3·65	4·19	65·0	73·4	51·2	46·0	2·62	3·20	70·3	98·4	54·0	98·4	1·25	1·43
Merredin State Farm	70·0	82·5	41·1	28·3	0·56	0·92	71·6	85·9	47·9	35·3	3·14	0·74	82·8	99·3	53·4	42·0	*Nil*	0·43
Northam	70·1	81·0	43·6	34·0	1·08	1·64	72·1	90·0	49·2	37·6	3·51	0·98	82·2	100·2	53·8	43·0	0·07	0·39
York	68·9	80·0	43·1	32·5	0·68	1·63	70·9	86·5	48·4	38·0	4·51	1·01	81·1	100·0	52·6	43·0	0·02	0·42
Narrogin State Farm	65·2	74·0	42·0	29·9	1·40	2·36	67·3	80·0	44·1	33·6	3·24	1·40	77·1	97·6	48·0	39·6	0·19	0·57
Katanning	65·1	74·1	43·7	35·0	1·58	1·98	67·3	82·0	46·0	38·0	2·09	1·54	76·6	101·0	50·0	42·0	0·23	0·67
Cape Leeuwin .	62·9	73·8	53·8	44·0	2·67	3·49	64·6	84·0	55·0	50·0	2·09	2·90	68·0	75·0	57·1	49·8	1·21	1·23

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No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
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